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DEPARTMENT OF THE ARMY US ARMY INDUSTRIAL BASE ENGINEERING ACTIVITY ROCK ISLAND, ILLINOIS 61299

DRXIB-MT

3 Jun 80

SUBJECT: Metals Subcommittee Annual Report

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Inclosed is a copy of the Metals Subcommittee Annual Report for FY79. It describes the Subcommittee's activities for the year, planned activities for FY80 and gives an overview of the three Services' metals programs.

1 Incl

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Metals Subcommittee

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DRXIB-MT

4 Jan 80

SUBJECT: Metals Subcommittee Report

SEE DISTRIBUTION

- 1. Reference is made to Charter, DOD Manufacturing Technology Advisory Group, paragraph V D 1 and 2.
- 2. This document contains the Metals Subcommittee Report for 1979, as required by reference 1. Within it are the Subcommittee's analysis and findings concerning the three services' Metals Manufacturing Technology Programs for FY80, FY81, and the Five Year Planning period of FY81 through FY85. Subcommittee tasks for 1980 and letters initiating action on these tasks are included in Appendix D.
- 3. This Report is a compilation of many individuals' work and reflects the spirit of cooperation that exists among the members of the subcommittee.

GORDON NEY (

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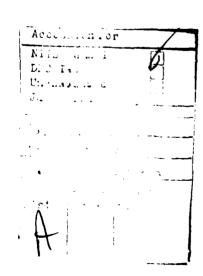
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LISTING OF FY81 METALS PROGRAM



INTRODUCTION

METALS SUBCOMMITTEE

METALS PROGRAM FUNDING SUMMARY

REVIEW OF METALS TECHNOLOGIES

SUMMARY

THIS REPORT IS DIVIDED INTO FOUR PARTS. THE FIRST PART WILL DISCUSS FUNDING LEVELS FOR FY80, 81 AND BEYOND. A DISCUSSION OF THE MAJOR TECH-NOLOGY AREAS WITHIN THE METALS PROGRAM WILL THEN FOLLOW, FINALLY, PAST THE METALS SUBCOMMITTEE. THE SECOND PART WILL PRESENT AN OVERVIEW OF AND FUTURE ACTIVITIES WILL BE SUMMARIZED,

OBJECTIVE

TO PROVIDE A FORUM FOR THE EXCHANGE OF TECHNICAL INFORMATION AND IDEAS DEALING WITH ADVANCED METAL PROCESSES AND TO OBTAIN THE MAXIMUM UTILIZATION OF THE FUNDS ALLOCATED TO ADVANCING THE PROCESSING OF METALS

PREVENT DUPLICATION, PROMOTE JOINT EFFORTS WHERE APPROPRIATE, AND STIMU-THE METAL SUBCOMMITTEE SEES ITS OBJECTIVE AS PROVIDING A FORUM FOR ALLOCATED TO ADVANCING THE PROCESSING OF METALS. WE ARE ATTEMPTING TO THE EXCHANGE OF TECHNICAL INFORMATION AND IDEAS DEALING WITH ADVANCED LATE THE APPLICATION OF ADVANCED TECHNOLOGY TO PROBLEM AREAS NOT PRE-METAL PROCESSES AND TO OBTAIN THE MAXIMUM UTILIZATION OF THE FUNDS VIOUSLY CONSIDERED.

AREA OF RESPONSIBILITY

THE METALS SUBCOMMITTEE DEALS WITH ALL PROCESSES REQUIRED TO PRODUCE METALS AND METAL PRODUCTS AND CERAMIC PRODUCTS

SERVICE PROGRAMS IN A WAY THAT EACH SERVICE, WORKING BY THEMSELVES, CANNOT. PROCESSES ASSOCIATED WITH MANUFACTURING CERAMIC PRODUCTS BECAME A NEW CONSEQUENTLY, WE CONCENTRATE ON THOSE TECHNOLOGIES THAT ARE COMMON, OR IN METALS, METAL PRODUCTS, AND CERAMIC PRODUCTS. THIS IS A VERY BROAD AREA; THE METALS SUBCOMMITTEE DEALS WITH ALL PROCESSES REQUIRED TO PRODUCE OUR OPINION, SHOULD BE COMMON AMONG THE SERVICES. BY CONCENTRATING ON THESE TECHNOLOGIES, WE ARE ABLE TO FAVORABLY INFLUENCE THE INDIVIDUAL

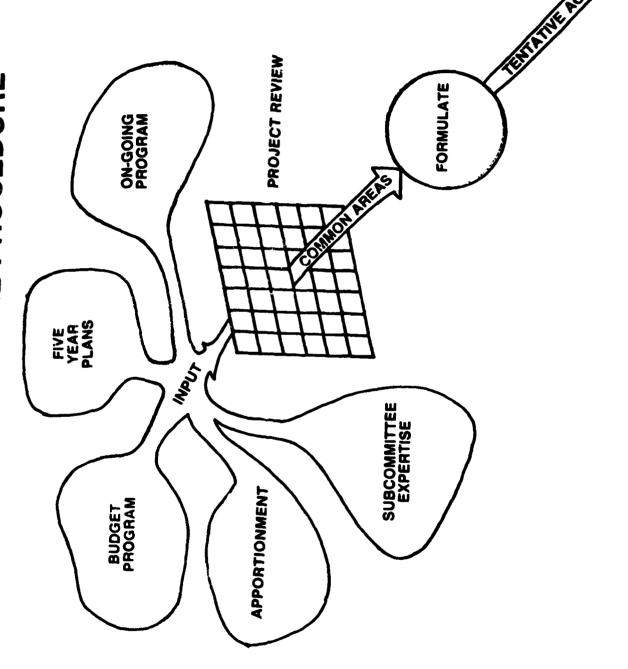
AREA OF RESPONSIBILITY OF THE METALS SUBCOMMITTEE THIS YEAR.

MEMBERSHIP

| | PERSONNEL | ORGANIZATIONS |
|-----------|-----------|---------------|
| ARMY | 16 | 12 |
| HAVY | 01 | • |
| AIR FORCE | 9 | 7 |
| NASA | 2 | 2 |
| | 34 | 25 |

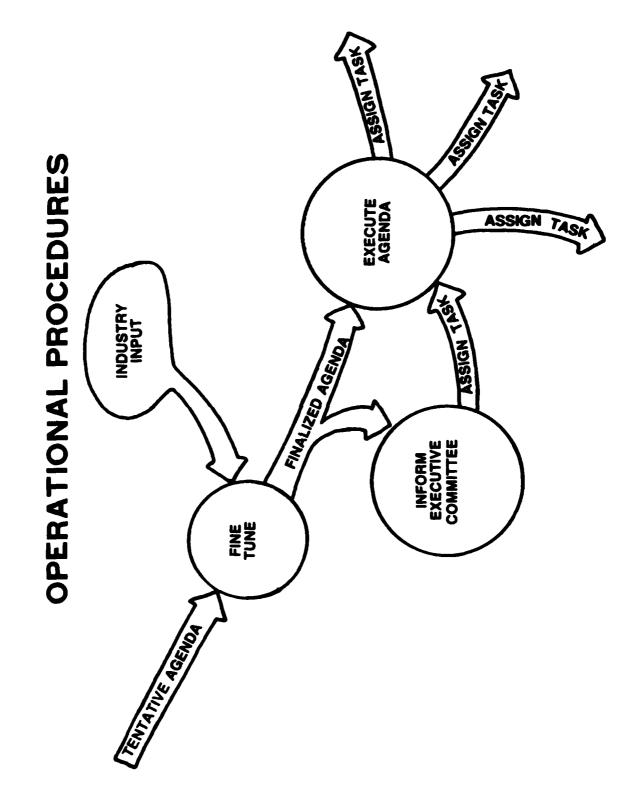
THE PROPER PEOPLE INVOLVED WHETHER THEY ARE MEMBERS OR NOT. AN ESTIMATED 300 INDIVIDUALS FROM GOVERNMENT AND INDUSTRY HAVE BEEN INVOLVED IN OUR MEMBERS ONLY. IN FACT, THE SUBCOMMITTEE FEELS IT IS IMPORTANT TO HAVE THE METALS SUBCOMMITIEE HAS 34 MEMBERS REPRESENTING 25 DIFFERENT ORGANIZATIONS. HOWEVER, SUBCOMMITTEE ACTIVITIES ARE NOT LIMITED TO ACTIVIES THIS YEAR.

OPERATIONAL PROCEDURE



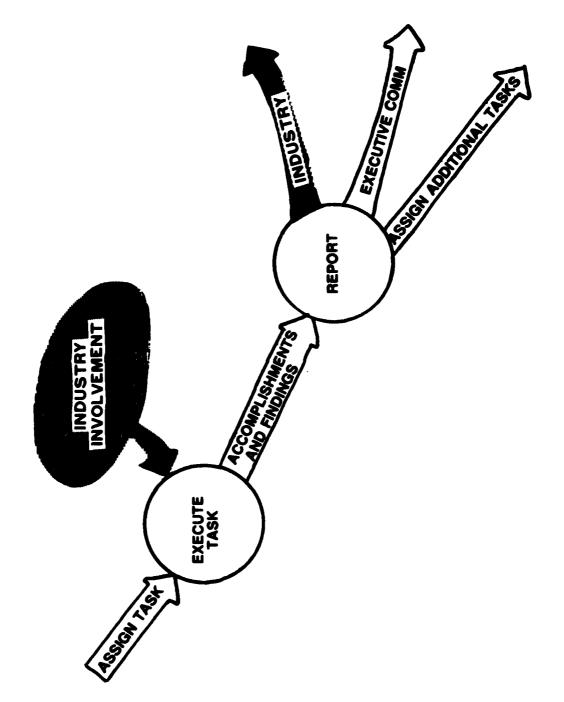
A resident medicinal and a facility of the second

THIS CHART AND THE NEXT TWO CHARTS EXPLAIN THE OPERATIONAL PROCEDURE USED YEAR PLAN, THE BUDGET PROGRAM, THE CHANGES THAT HAVE OCCURRED TO LAST YEAR'S FASKS TO BE PERFORMED AND THE TIME FRAMES TO ACCOMPLISH THEM ARE DETERMINED. BY THE METALS SUBCOMMITTEE, IT BEGINS WITH INPUT THAT CONSISTS OF THE FIVE BUDGET DURING APPORTIONMENT, AND THE ON-GOING PROGRAM. USING THE EXPERTISE AREAS, A PRELIMINARY PLAN FOR THE FOLLOWING YEAR IS FORMULATED. THE COMMON WITHIN THE SUBCOMMITTEE, THE PROJECT INFORMATION IS REVIEWED TO ASCERTAIN AREAS WHICH CAN BE MOST PROFITABLY INFLUENCED ARE THEN SELECTED; AND THE THE COMMON AREAS OR AREAS THOUGHT TO BE COMMON. FROM THE LIST OF COMMON THIS BECOMES THE TENTATIVE AGENDA.



WHEN THE AGENDA IS FINALIZED, THE EXECUTIVE COMMITTEE IS INFORMED. THEY MAY IN TURN MODIFY THE AGENDA BY EITHER ADDING OR DELETING TASKS. THE TASKS ARE ARE WORTHWHILE AND IF THERE ARE ANY IMPORTANT TASKS WHICH ARE NOT INCLUDED. WITHIN THE SERVICES, WHETHER THEY ARE PART OF THE SUBCOMMITTEE OR NOT. IT IS IMPORTANT TO BRING TOGETHER THE MOST KNOWLEDGEABLE INDIVIDUALS IN EACH AT THIS POINT IS CONSIDERED VITAL IN ORDER TO DETERMINE WHETHER THE TASKS ATTEMPT IS MADE TO ASSIGN THESE TASKS TO THE MOST APPROPRIATE INDIVIDUALS THIS AGENDA IS FINE TUNED AT THE ANNUAL MTAG MEETING. INDUSTRY INPUT THEN ASSIGNED TO VARIOUS SMALL GROUPS. TO MAKE THIS PROCESS WORK, AN SERVICE TO ATTACK EACH SPECIFIC PROBLEM OR SET OF PROBLEMS.

OPERATIONAL PROCEDURES



والمراجع المنافظة والمال ووالمالي والمالية

INDUSTRY COULD PLAY A VITAL ROLE BY PROVIDING VALUABLE INPUT FOR CONSIDER-ONCE THE TASKS HAVE BEEN ASSIGNED, THE GROUPS EXECUTE THEM. THEY ARE PENDING ON THEIR NATURE. INDUSTRY, AS AN EXAMPLE, SHOULD NOT BE INVOLVED RESPONSIBLE FOR PLANNING ANY MEETINGS THAT MAY BE REQUIRED TO OBTAIN THE DESIRED RESULTS. INDUSTRY MAY BE INVOLVED IN EXECUTING THESE TASKS, DE-ARRANGEMENTS FOR A SPECIFIC JOINTLY FUNDED EFFORT. ON THE OTHER HAND, IN A TASK WHERE TWO OR MORE SERVICES ARE TRYING TO DETAIL THE WORKING ATION IN PLANNING MULTI-SERVICE EFFORTS IN A BROAD TECHNOLOGY AREA.

IASK ARE DOCUMENTED. THESE ARE PUT INTO A REPORT AND FORWARDED TO THE ACCOMPLISHMENTS, FINDINGS, AND RECOMMENDATIONS RESULTING FROM EACH EXECUTIVE COMMITTEE AND INDUSTRY WHERE APPROPRIATE. WHEN ADDITIONAL FASKS ARE REQUIRED, THEY ARE ASSIGNED; AND THIS COMPLETES THE CYCLE.

PROJECT REVIEW

PURPOSE

TO REVIEW THE BUDGET AND APPORTIONMENT PROJECTS FOR DUPLICATION OF EFFORT AND POTENTIAL MULTI-SERVICE EFFORTS.

APPORTIONMENT PROGRAMS OF THE THREE SERVICES, THE PURPOSE OF THIS MEETING THE CORE OF THIS OPERATIONAL PROCEDURE IS THE PROJECT REVIEW, DURING IS TO IDENTIFY DUPLICATION OF EFFORT AND POTENTIAL MULTI-SERVICE EFFORTS. THE SUMMER OF EACH YEAR, THE SUBCOMMITTEE MEETS TO REVIEW THE BUDGET AND

FOR IDENTIFYING POTENTIAL DUPLICATION OF EFFORT. BASICALLY, THIS APPROACH AT OUR FIRST MEETING IN SEPTEMBER 74, WE ADOPTED A SYSTEMATIC APPROACH IS STILL USED TODAY.

PROJECT REVIEW

APPROACH

- DISCUSS PROJECTS
- CLASSIFY PROJECTS
- MATERIAL PROCESS
- APPLICATION
- GROUP PROJECTS BY PROCESS
- DISCUSS THE SIMILARITIES AND DIFFERENCES AMONG THE EFFORTS
- RECOMMEND APPROPRIATE ACTIONS

PROCESS. THE THIRD STEP IS TO GROUP PROJECTS BY SIMILAR PROCESSES FOLLOWED SO THAT ALL SUBCOMMITTEE MEMBERS KNOW WHAT EACH SERVICE'S PROGRAM CONSISTS BEING ADDRESSED, THE MATERIAL BEING PROCESSED, AND THE APPLICATION OF THE IT CONSISTS OF FIVE STEPS. THE FIRST STEP IS TO DISCUSS EACH PROJECT GROUPED PROJECTS. FROM THIS DISCUSSION, THE APPROPRIATE ACTION PLAN IS OF. THE NEXT STEP IS TO CLASSIFY THE PROJECTS ACCORDING TO THE PROCESS BY A DISCUSSION OF THE SIMILARITIES AND DIFFERENCES AMONG THE SIMILARLY FORMULATED.

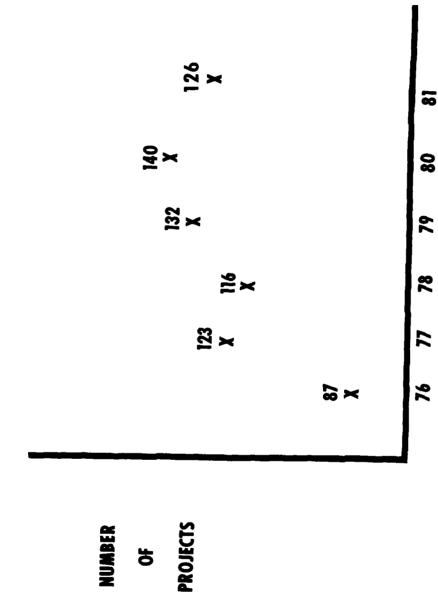
METAL REMOVAL

APPLICATION TUR BINE ENGINES (AF) (A) PROJECTILES (A) MATERIAL * SUPERALLOYS STEEL . HOT MACHINING **PROCESS**

CATION BETWEEN THE STEEL AND SUPERALLOY EFFORTS. HOWEVER, A POTENTIAL DUPLICATION CLASSIFYING ALL THE PROJECTS ACCORDING TO THEIR PROCESS, MATERIAL AND APPLICATION, MORK WOULD USE A LASER AS THE HEAT SOURCE. WE CONCLUDED THAT THERE WAS NO DUPLI-FROM OUR DISCUSSIONS, WE FOUND THAT THE ARMY'S STEEL PROJECTILE WORK IS USING A AND BOTH ARE AIMED AT TURBINE ENGINE COMPONENTS. THEREFORE, OUR RECOMMENDATION PLASMA TORCH AS THE HEAT SOURCE WHEREAS THE ARMY'S AND AIR FORCE'S SUPERALLOY WE FOUND THAT HOT MACHINING WAS BEING PURSUED BY BOTH THE ARMY AND AIR FORCE. EXISTS BETWEEN THE ARMY AND AIR FORCE SUPERALLOY WORK, BOTH WILL USE LASERS IS FOR THE SPONSORS OF THESE PROGRAMS TO MEET AND FORMULATE A MULTI-SERVICE THIS CHART WILL BETTER ILLUSTRATE OUR APPROACH. IN THIS EXAMPLE, AFTER PROGRAM. THIS WILL ENSURE THAT NO DUPLICATION TAKES PLACE.

PROJECT REVIEW

WORK LOAD



FISCAL YEAR

21

INCREASED SUBSTANTIALLY OVER THE YEARS. THIS INCREASE HAS LED TO GREATER PROBLEMS WHILE OUR APPROACH TO THE PROJECT REVIEWS HAS NOT CHANGED, OUR METHODS HAVE. WE HAVE HAD TO IMPROVE OUR METHODS BECAUSE THE NUMBER OF PROJECTS REVIEWED HAS IN MAINTAINING ACCURATE DATA AND ASSURING ADECUATE COVERAGE.

PROJECT REVIEW

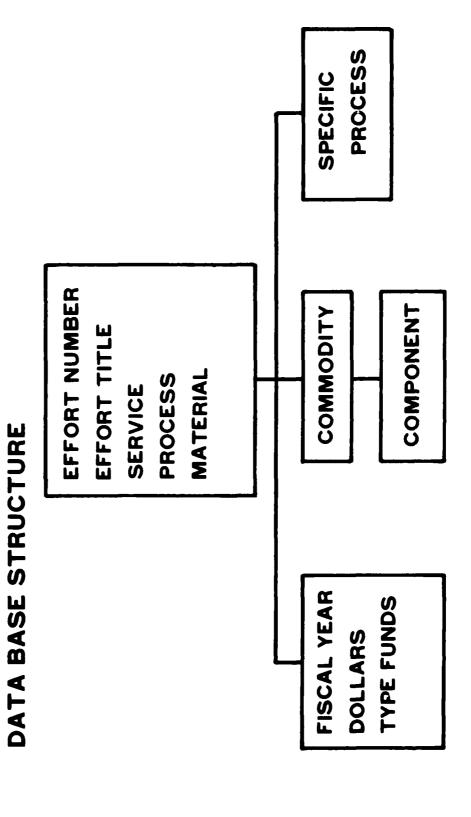
METHODS IMPROVEMENT

EXPERIMENTED WITH USING AUTOMATED DATA BASE FOR THE FY80 BUDGET PROGRAM

EXPANDED THE SYSTEM TO INCLUDE BUDGET,
APPORTIONMENT AND ACTIVE PROJECTS

THIS HAS HELPED US TO DO A MORE COMPLETE AND THOROUGH JOB OF IDENTIFYING POTENTIAL DUPLICATION. WE FIRST EXPERIMENTED WITH AUTOMATED DATA PROCESSING WHEN WE ESTAB-WORKED SO WELL, THAT DURING CY79 WE EXPANDED THE DATA BASE TO INCLUDE THE BUDGET, THEREFORE, ONE OF THE IMPROVEMENTS IS THE USE OF AUTOMATED DATA PROCESSING. LISHED A COMPUTERIZED DATA BASE FOR THE FY80 BUDGET PROGRAM. THIS EXPERIMENT APPORTIONMENT AND FUNDED PROGRAMS WHICH ARE CURRENTLY ON-GOING.

PROJECT REVIEW



SELECTED FROM A LIST AND INCLUDE PROCESSES SUCH AS FORGING, CASTING AND POWDER METALLURGY, AND MATERIALS SUCH AS STEEL, TITANIUM AND ALUMINUM. THE SECOND LEVEL HAS THREE MAIN DATA FIRST LEVEL CONTAINS DATA PERTINENT TO THE EFFORT. THE PROCESS AND MATERIAL ENTRIES ARE WEAPONS. THE THIRD LEVEL, COMPONENTS, STEMS FROM THE COMMODITIES SUPPORTED AND ARE ALSO FATTED IN THE SENSE THAT THEY ARE NOT SELECTED FROM A PREDETERMINED LIST. THE COMMODITY ENTRIES ARE SELECTED FROM A LIST WHICH CONSISTS OF ENTRIES SUCH AS SHIPS, AIRCRAFT AND SECTIONS. THESE DATA SECTIONS DEAL WITH FUNDING, THE SPECIFIC PROCESSES BEING PURSUED THE DATA BASE IS STRUCTURED AS SHOWN HERE, USING SYSTEM 2000, AN M.R.I. DATA BASE MANAGEMENT SYSTEM. IT IS A RELATIVELY SIMPLE STRUCTURE CONTAINING THREE LEVELS. THE AND THE COMMODITY TO WHICH IT IS BEING APPLIED. THE SPECIFIC PROCESSES ARE FREE FOR-FREE FORMATTED.

WE CURRENTLY HAVE 325 EFFORTS WORTH 200 MILLION DOLLARS ACCOUNTED FOR IN OUR DATA

PROJECT REVIEW

| | ATION-COOLED | SPECIFIC PROCESS | BONDING, DIFFUSION ETCHING |
|-------------------------------|--|------------------|-------------------------------|
| 111.6 | LOW COST TRANSPIRATION-COOLED COMBUSTOR LINER | COMPONENT | TURBINE ENGINES COMBUSTOR |
| FUNDING STATUS | 8 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 | APPLICATION | AIRCRAFT |
| YEAL EFFORT NO SERVICE FUN | ARMY | MATERIAL | SUPERALLOY |
| EFFORT N | 1 7322 | | • |

| | NE AND COMBUSTOR | SPECIFIC PROCESS | BONDING, DIFFUSION ETCHING |
|-------------------------|---|------------------|---------------------------------|
| TITLE | MT FOR ADVANCED VANE AND COMBUSTOR Fabrication | COMPONENT | TURBINE ENGINES COMBUSTOR VANES |
| YEARS OF FUNDING STATUS | 80 81 82 | APPLICATION | MISSILES |
| YEEFORT NO SERVICE FL | 02M205 AIR FORCE | MATERIAL | SUPERALLOY |
| | | | |

TWO PROJECTS SHOWN HERE ARE CONCERNED WITH APPLYING DIFFUSION BONDING TECHNOLOGY THIS DATA BASE SYSTEM IS USED TO SORT PROJECTS BY THEIR PROCESS, MATERIAL TO TRANSPIRATION COOLED TURBINE ENGINE COMPONENTS. THE PROJECTS REPRESENT A AND APPLICATION AND PRINT SELECTED DATA ELEMENTS IN THE FORMAT SHOWN. THE POTENTIAL JOINTLY FUNDED EFFORT BETWEEN THE ARMY AND AIR FORCE.

POWDER METALLURGY

| SPECIFIC PROCESS AREA | EXTRUSION PREFORMS HOT ISOSTATIC PRESSING | ISOSTATIC PRESSING ISOTHERMAL FORGING | OTHER (PM APPROACH) | PM FORGING | PREP | PRESS AND SINTER | POWDER MANUFACTURE | PRESSING, VACUUM HOT |
|--------------------------|---|---------------------------------------|---------------------|------------|------|------------------|--------------------|----------------------|
| FREQUENCY | 12 | - - | | m | _ | . 7 | ~~ | , - |

ANOTHER MEANS BY WHICH THIS DATA BASE CAN BE USED TO HELP DETERMINE POTENTIAL SPECIFIC PROCESS. AN EXAMPLE OF THIS DATA IS SHOWN HERE FOR POWDER METALLURGY. WHEN THIS DATA IS COUPLED WITH DATA PRESENTED IN THE PREVIOUS CHART, IT IS A DUPLICATION OF EFFORT IS TO IDENTIFY THE NUMBER OF EFFORTS WHICH DEAL WITH A VERY POWERFUL TOOL TO AID IN DETERMINING POTENTIAL DUPLICATION OF EFFORT.

METALS PROGRAM FUNDING SUMMARY

HISTORICAL TRENDS

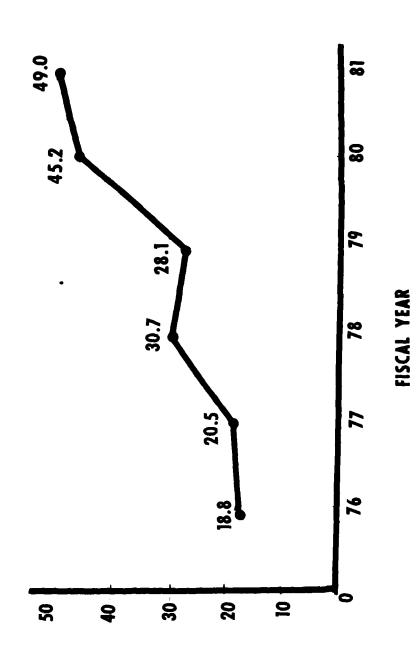
● CURRENT BUDGET PROGRAM ANALYSIS

FUTURE PROJECTIONS

OF HISTORICAL TRENDS, CURRENT BUDGET PROGRAM ANALYSES AND FUTURE PROJECTIONS. THE SECOND PART OF THIS REPORT PROVIDES THE METALS PROGRAM DATA FUNDING SUMMARY. THE TYPES OF DATA AND ANALYSES PROVIDED FALL INTO THE CATEGORIES

FUNDING HISTORY





THIS CHART SHOWS THE GROWTH THAT HAS TAKEN PLACE IN THE METALS PROGRAM. ONE CAN SEE THAT THE PRUGRAM HAS MORE THAN DOUBLED IN SIZE SINCE FY76. IT HAS GROWN FROM APPROXIMATELY 20 MILLION IN FY76 TO 49 MILLION IN FY81.

SUMMARY OF FY80 PROGRAM CHANGES

| | | FY 80 ESTI | FY 80BUDGET ESTIMATE | CURI FY80 PR | CURRENT FY80 PROGRAM |
|----------|-------|---------------|-------------------------|-----------------|-------------------------|
| IRMY | | (61) | 17,138 | (65) | 16,614 |
| IAVY | | (24) | 11,566 | (17) | 7,690 |
| IR FORCE | | (55) | 23,326 | (47) | 20,865 |
| | TOTAL | 1140) | 52,030 | (123) | 45,169 |

CHART SHOWS THE CHANGES THAT HAVE TAKEN PLACE IN THE FY30 PROGRAM. THERE HAS NOW LET ME DISCUSS THE FUNDING PICTURE FOR FY80, FY81 AND BEYOND. THIS BEEN A DECREASE IN THE PROGRAM OF 7 MILLION DOLLARS. MOST OF THIS DECREASE IS ACCOUNTED FOR BY THE CUT IN FUNDS SUSTAINED BY THE NAVY.

SUMMARY OF FY81 METALS PROGRAM

| NUMBER VALUE OF IN PROJECTS THOUSANDS | 919'21 99 | 21 12,500 | | 900 07 |
|---------------------------------------|-----------|-----------|-----------|--------|
| | ARMY | HAVY | AIR FORCE | |

THE FY81 METALS PROGRAM IS MADE UP OF 126 PROJECTS WORTH 49 MILLION DOLLARS. THE ARMY HAS 66 PROJECTS WORTH 17.5 MILLION DOLLARS; THE NAVY HAS 21 PROJECTS WORTH 12.5 MILLION; AND THE AIR FORCE HAS 39 PROJECTS WORTH 19.

FY81 METALS PROGRAM DISTRIBUTIONS

COMMODITY/SERVICE

| | ARMY | NAVY | AIR FORCE | TOTAL |
|------------------|------|------|-----------|-----------|
| IRCRAFT | 6.1 | 13.2 | 28.3 | 47.6 |
| AISSILES | 1.9 | 0 | 4.8 | 10.3 |
| HIPS | • | 4.0 | 0 | 3. |
| VEAPONS | 10.0 | 0 | 0 | 10.0 |
| MAUNITION | 8. | 2.6 | 4.9 | 14.3 |
| AND VEHICLES | 8.6 | 0 | 0 | 8.6 |
| UPPORT EQUIPMENT | ∞. | 0 | 0 | €. |
| TOTAL | 34.2 | 24.2 | 41.6 | 100.0 |

THE SERVICE SUPPORTING THE WORK, THE TECHNOLOGY BEING EXPLOITED, AND THE COMMODITY TO WHICH IT IS BEING APPLIED. THE NEXT THREE CHARTS SHOW THE PERCENTAGE BREAK-THERE ARE THREE MAIN COMPONENTS OF THE MANUFACTURING TECHNOLOGY PROGRAM -OUT OF THE METALS PROGRAM BY THESE COMPONENTS.

CHANGE OVER LAST YEARS' FIGURES IS THAT AIRCRAFT HAS BEEN SIGNIFICANTLY REDUCED BY 7.5 PERCENTAGE POINTS. THE OTHER COMMODITIES HAVE BEEN INCREASED SLIGHTLY SHOWN HERE IS THE BREAK-OUT BY COMMODITY AND SERVICE. THE SIGNIFICANT WITH AMMUNITION AND WEAPONS INCREASING THE MOST.

FY81 METALS PROGRAM DISTRIBUTIONS

TECHNOLOGY/SERVICE

| | ARMY | MAVY | AIR FORCE | TOTAL | |
|---------------------|------|------------|-----------|-------|---|
| FORGING | 6.5 | 1.6 | 3.5 | 11.6 | |
| CASTING | 2.4 | 5.9 | 4.7 | 13.0 | |
| POWDER METALLURGY | | 2.4 | 8.7 | 1.8 | |
| EXTRUSION & ROLLING | 1.2 | • | 2.0 | 3.2 | _ |
| METAL REMOVAL | 12.5 | 9 . | 5.4 | 18.5 | |
| JOINING | 3.5 | 3.9 | 5.9 | 13.3 | |
| SURFACE TREATMENT | ** | 4.1 | 3.5 | 12.0 | |
| FORMING | 7.3 | 5.3 | 6.1 | 12.7 | |
| OTHER | 1.7 | ₹. | <u>~</u> | 3.9 | |
| TOTAL | 34.2 | 24.2 | 41.6 | 100.0 | |

THIS CHART SHOWS THE PROGRAM BROKEN-OUT BY TECHNOLOGY AND SERVICE. SURFACE TREATMENT HAS SIGNIFICANTLY INCREASED OVER WHAT IT HAS BEEN IN THE PAST. SMALL CHANGES HAVE OCCURRED IN THE OTHER TECHNOLOGIES,

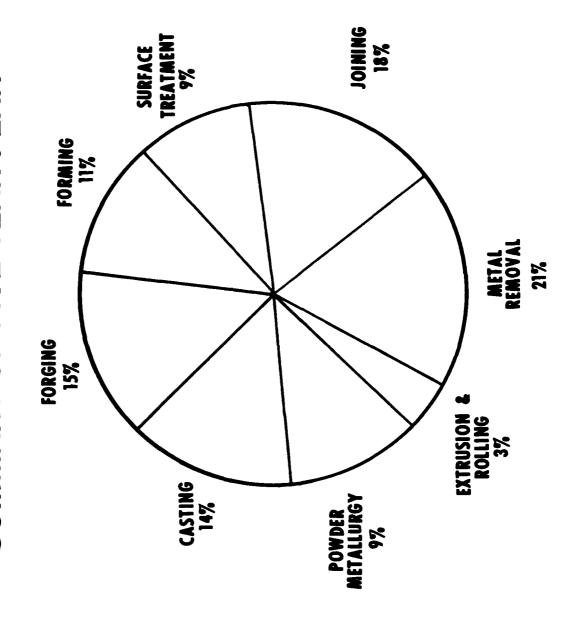
FY81 METALS PROGRAM DISTRIBUTIONS

COMMODITY/TECHNOLOGY

| | | | | 1.0 | Mo | | ' | | | | |
|-------------------|---------|---------|-----|-----|------|-------------------|------|-------------------|------------|------------|--|
| | FORGING | ONILSVO | ~ 0 | | TON | NINION IN LOUNING | 7.5 | SURING FORMING | OTHER SAME | INIOI | |
| AIRCRAFT | 3.1 | 7.4 | | 1.7 | 1 | 6.0 | | 4.2 | 1.0 | | |
| MISSILES | 1.4 | 4.2 | 0 | 0 | 1.6 | • | 0 | œ. | .7 | 10.3 | |
| SHIPS | 0 | 0 | 0 | 0 | 0 | 2.6 | 7: | 3.9 | ۸: | 7.8 | |
| WEAPONS | 0 | હ | .7 | 0 | 6.1 | ₹. | 2.5 | 0 | 0 | 10.0 | |
| AMMUNITION | 6.4 | 0 | 9. | 1.5 | ₹. | 2.4 | • | 2.4 | 0 | 14.3 | |
| LAND VEHICLES | 7. | = | 0 | 0 | 3.4 | 1.3 | œ. | ₹. | 6. | •• | |
| SUPPORT EQUIPMENT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ••• | 0 | |
| TOTAL | 11.6 | 13.0 | 1.8 | 3.2 | 18.5 | 13.3 | 12.0 | 12.7 | 3.9 | 90 | |

FORGING, THE LARGEST PERCENTAGE OF EXPENDITURES IN EACH TECHNOLOGY OCCURS IN WHERE ALL TECHNOLOGIES ARE BEING PURSUED IS AIRCRAFT. EXCEPT IN THE CASE OF THE LAST BREAK-OUT IS BY COMMODITY AND TECHNOLOGY. THE ONLY COMMODITY AIRCRAFT. METAL REMOVAL IS THE TECHNOLOGY WITH THE LARGEST PERCENTAGE OF EXPENDITURES.

SUMMARY OF FIVE YEAR PLAN



OUR ANALYSIS OF THE THREE SERVICES' FIVE YEAR PLANS REVEALS THAT APPROXIMATELY 240 MILLION DOLLARS WILL BE EXPENDED FOR METALS PROCESSING IN THE NEXT FIVE YEARS. THE FUNDS WILL BE DIVIDED AMONG THE MAJOR PROCESSING AREAS AS SHOWN HERE.

FORGING

FIVE YEAR FUNDING FORECAST

■ 34-38 MILLION

COMPARISON OF FIVE YEAR PLANS

78-82

79-83

FISCAL YEARS

23%

80-84

81-85

COMPARISON OF INDIVIDUAL YEAR PROGRAMS

79

78

~

80

FISCAL YEAR

A 1... 1

34-38 MILLION DOLLARS. THE FIVE YEAR PLAN COMPARISON PROJECTS AN INCREASE IN FORGING'S SHARE OF THE METALS PROGRAM WHILE THE COMPARISON OF INDIVIDUAL BUD-GET YEAR PROGRAMS SHOWS THAT ITS SHARE IS THE SAME AS LAST YEAR. BASED UPON IN THE FORGING AREA, WE ARE PROJECTING FIVE YEAR EXPENDITURES OF BETWEEN THESE FIGURES, IT APPEARS THAT A RENEWED INTEREST IN FORGING TECHNOLOGY HAS DEVELOPED AND THAT FORGING EXPENDITURES WILL INCREASE.

FORGING

TECHNICAL OBJECTIVES

- REDUCE THE "ART" FACTOR
- MPROVE MATERIAL UTILIZATION
- REDUCE TOOLING COSTS
- MINIMIZE ENERGY USED

THE TECHNICAL OBJECTIVES BEING SOUGHT IN THE FORGING AREA ARE TO REDUCE THE ART FACTOR, IMPROVE MATERIAL UTILIZATION, REDUCE TOOLING COSTS, AND MINIMIZE THE ENERGY USED,

FORGING

2 CAD/CAM DIE DESIGN

FREQUENCY SPECIFIC PROCESS

- COINING
- CONTROLLED DEFORMATION
- FORGING, HEADER
- FORGING, INTERNAL SHEAR
 - FORGING, ISOTHERMAL
 - S FORGING, PRECISION 6 FORGING, ROTARY
 - I FORGING, UPSET
- 1 FORGING, WARM
 - 1 HEADING PRESS
- **MECHANICAL TREATMENTS**
 - NOSING
- **PIERCING**
- PM FORGING
- 1 PUNCH CHANGES
- SWAGING, TAPER

THE TYPES OF FORGING PROCESSES BEING PURSUED AND THE NUMBER OF PROJECTS PURSUING THOSE PROCESSES ARE SHOWN ON THIS CHART.

FORGING

FY81 PROGRAM REVIEW

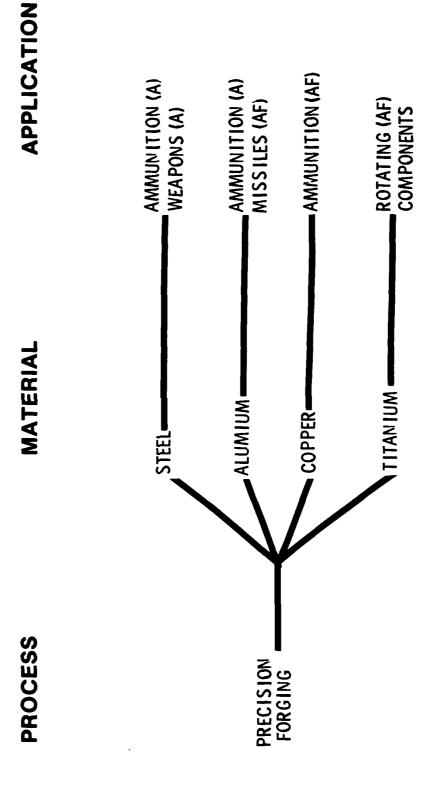
15 PROJECTS REVIEWED

■ COMMON AREAS IDENTIFIED

PRECISION FORGING

THE SUBCOMMITTEE REVIEWED 15 FY81 PROJECTS. WE IDENTIFIED PRECISION FORGING AS A COMMON AREA AMONG THE SERVICES.

FORGING



AREA PARTS (GREATER THAN 200 SQUARE INCHES) BY ISOTHERMAL TECHNIQUES. THERE-VOLUME PARTS WHEREAS THE AIR FORCE IS ADDRESSING A SMALL NUMBER OF LARGE PLAN THE ARMY'S EFFORT IN PRECISION FORGING OF ALUMINUM IS DIRECTED AT HIGH FORE, WE CONCLUDED THERE IS NO DUPLICATION OF EFFORT.

FORGING

FY 80 PROGRAM CHANGES REVIEW

● 2 NEW PROJECT REVIEWED

COMMON AREAS IDENTIFIED

D NO NEW AREAS

AREAS THAT HAD NOT BEEN ALREADY IDENTIFIED IN THE REVIEW OF THE FY81 PROJECTS. THE SUBCOMMITTEE REVIEWED TWO NEW FYSO PROJECTS AND FOUND NO NEW COMMON

THE PROJECTS ARE SORTED BY THE MATERIAL BEING FORGED AND ITS APPLICATION. APPORTIONMENT AND BUDGET PROJECTS WHICH HAVE BEEN CLASSIFIED AS FORGING. THE FOLLOWING COMPUTER PRINTOUT CONTAINS THE DATA FOR ALL ACTIVE,

| # # # | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | 203 | 71716 | |
|-------------|--------------|------------|----------------------------|----------|--|---|
| * * * | 1 6120 | ₽ ₩ | 75 | | IMPROVED HELICOPTER SKIN MATERIAL BY CONTROLLED SOLIDIFICATION | BY CONTROLLED SOLIDIFICATION |
| | | MATERIAL | APPLICATION | NOIL | COMPONENT | SPECIFIC PROCESS |
| | | ALUMINUM | AIRCRAFT | | AIRFRAME | THEREAL TREATMENTS TRETANICAL TREATMENTS |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | 801 | TITLE | |
| * * | 5 4309-10 | ARMY | 91 | | FORMING TAIL FIN FOR APPSOS PROJECTILE | 71LE |
| | | MATERIAL | APPLICATION | NOIL | COMPONENT | SPECIFIC PROCESS |
| | ALUMINUM | ALUMINUM | AMMUNITION | NO | AMMUNITION TAIL FING | FORGING, PRECISION HEAT TREATMENT |
| | EFF GRT NO | SERVICE | YEARS OF FUNDING STATUS | s n z | 7171.6 | |
| * | 5 4309-11 | > I | A 1 | | FORMING BOOM OF HEAT AMMO BY UPSET FORGING | FORGING |
| • | | MATERIAL | APPLICATION | LION | COMPONENT | SPECIFIC PROCESS |
| | • | ALUMÍNUM | AMMUNITION | Ī | TAIL BCOM EXTENSION | FORGING, UPSET |
| | £ F F ORT 20 | SERVICE | YEARS OF FUNDING STATUS | rus S | TITLE | |
| | 5 4184 | A 12 34 4 | 0 | | FORM GABOT SEGMENTS TO NET SHAPE ON APPISOS AMAD | DIE SOUPLE OF THE |
| | | MATERIAL | APPLICATION | 10N | COMPONENT | SPECIFIC PROCESS |
| | | ALUMÍNUM | AMMUNITION | v O | SABOT | FORGING, PRECISION HEAT TREATHERT |
| | | | | | | |

organia daggaga sa

| • | | | 0 | | | | |
|-----|--|--------------|---|------------|---|-------------------|-------------------------|
| | EFFORT NO | SERVICE | FUNDING STATUS | US TITLE | 9 | | |
| : . | R 3204 | ARMY | 7.8 | ILNI | INTERNAL SHEAR FORGING FOR MISSILE PRIMARY STRUCTURE | PRIMARY | STRUCTURE |
| | | MATERIAL | APPLICATION | NOI | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | 9 8 9 0 0 0 0 | ALUMINUM | Ĭ | | MIGGILEG PRIMARY GTRUCTURE GATIFFENING RING BING WPLICE AND STATE | FORGING, | FORGING, INTERNAL SHEAR |
| | EFFORT NO | | | US TITLE | | | |
| | 02M14S | AIR FORCE | 99 C | | MT FOR LARGE ALUMINUM PRECISION FORGINGS | SEINGS | |
| ; | | MATERIAL | APPLICATION | ION | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | | ALUMINUM | ON TOOLE STATE OF THE STATE OF | | STRUCTURE | FORGING PRECISION | RECISION |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | US TITLE | ינ י | | |
| | 08H12B | AIR FORCE | e0 e0 | E E | MT FOR WAAM METAL PARTS | | |
| | | MATERIAL | APPLICATION | 10N | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | COPPER | AOITINOMMA | | ARMOR ANT MIDE AREA | | |
| | EFF ORT NO | | YEARS FUNDIN | | W | | |
| | DN800559 | > 4 2 | 79 | PROC | PRODUCTION OF DU PENETRATORS | | |
| • | | MATERIAL | APPLICATION | 201 | COMPONENT | SPECIFIC PROCESS | PROCESS |
| k i | | ОТНЕЯ | NOTLINDER | Z | PROJECTILE, PENETRATOR | | |

| * | | | | YFARS OF | | | | |
|----------------|------------|--------|----------|---|-------------|------------------------------------|--|----------------------|
| ; | EFFORT NO | O. | SERVICE | FUNDING | STATUS | TITLE | | |
| | 5 4410 | | ARMY | 11 | | MFG TUNGSTEN PENETRATORS TO SHAPE | BY TAPER | SHAGING |
| • | | | MATERIAL | APP | APPLICATION | COMPONENT | SPECIFIC 6 | PROCESS |
| | | | OTHER | A P P P P P P P P P P P P P P P P P P P | AMENITION | METAL PARTS PROJECTILE | SEAGING, | |
| | EFFORT NO | Q | SERVICE | YEARS OF FUNDING | STATUS | | | |
| | 1 6673 | | ARMY | 7.3 | | PRECISION FORGING OF SPIRAL BEVEL | GEAR | |
| | | | MATERIAL | dá¥ | APPLICATION | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | | į | STEEL | AIR | A IRCRAFT | TRANGFIGGION GRANG | PRECISION | PRECISIÓN CLUSED-DIE |
| ; | EFECIRT NO | Ö | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| * * * * * * | 5 4189 | | A X X X | 70867 | | HIGH FRAGMENTATION STEEL PRODUCTIC | PRODUCTION PROCESS | |
| : | | | MATERIAL | dd¥ | APPLICATION | COMPONENT | SPECIFIC | PROCESS |
| | i | | STEEL | Σ 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | AMMUNITION | PROJECTILE BODY | FORGING, PRECISION HEAT TREATMENT | PRECISION |
| | EFFURT NO | ĵ Z | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| * | 5 4369 | | ARMY | 81 | | TECHNIQUES TO IMPROVE PROJECTILE C | CAVITY BUALITY | .117 |
| • | | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS | ROCESS |
| | | | STEEL | ₹ ¥ | AMMCNITION | PROJECTILE CAVITY | MULT PREPARATION PUNCH CHANGES COINING | IRATION Ges |

| EFFORT NO | 5 4401 | | | · | 5 4309-12 | | | EFFORT NO | 5 6759 | | 0 0 0 0 0 0 | EFFORT NO | 5 6716 | | |
|------------------|---|------------------|---------------|---------------------|-------------------------------------|------------------|-------------------------------------|---------------------|--|------------------|---|-----------|---|------------------|------------------------------|
| | | | i | 1 | | | 1 | _ | | | | | | | |
| SERVICE | ARMY | MATERIAL | STEEL | | > E & 4 | MATERIAL | STEEL | SERVICE | ₩ | MATERIAL | 1 3 5 8 | SERVICE | ₹ 1 | MATERIAL | STEEL |
| YEARS OF FUNDING | 8 | AP | ¥ (| YEARS OF FUNDING | 80.1 | ٩ | ¥ | YEARS OF FUNDING | 76 | AP | X 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | | 77 77 76 81 | 4 | ¥ |
| STATUS | | APPLICATION | NOIHINDER | STATUS | | PPLICATION | MECNITION | STATUS | | PPLICATION | MMUNITION | STATUS | | PPLICATION | MMUNITION |
| TITLE | HOT FORMING AND COLD HEADING OF FURE COMPONENTS | COMPONENT | FUZE | TITLE | FURMING OF STUB BASE CARTRIDGE CASE | COMPONENT | AMMUNITION STUB BASE CARTRIDGE CASE | TITLE | AUTOMATIC TRANGFER-HOT FORMING PRESSES | COMPONENT | METAL PARTS MORTAR | | DEVELOP COMPUTER-AIDED M | COMPONENT | METAL PARTS |
| | DING OF FURE COMPONENTS | SPECIFIC PROCESS | FORGING, MARR | | RIDGE CASE | SPECIFIC PROCESS | IE CASE FORGING, HEADER | | DRMING PRESSES FOR MORTAR AMMO | SPECIFIC PROCESS | MEADING PRESS | | DEVELOP COMPUTER-AIDED MODEL OF FORMING OPERATIONS FOR ARTILLERY MPTS | SPECIFIC PROCESS | ZOSIZG PIRACIZG DAFIZG |

| | EFFORT NO | © × | SERVICE | YEARS OF FUNDING S | STATUS TITLE | w |
|---------------|-------------|-------------|---------------------------------------|---|---|---|
| * * | 5 6681 | | ARMY | 78 | 1140 | OPTIMIZE PARAMETERS FOR |
| | | | MATERIAL | APPLI | APPLICATION | COMPONENT |
| # # # # | | | STEEL | AMMUNITION | ITION | METAL PARTS |
| ! | | • | • • • • • • • • • • • • • • • • • • • | # 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | PROJECTILES |
| | EFFORT NO | Q ► | SERVICE | YEARS OF FUNDING S | STATUS TITLE | w |
| * * | T 5024 | 7 | Α Σ Σ | 81 79 78 | ₽ | GEAR DIE DESIGN AND MFG UTILIZING COMPUTER TECHNOLOGY (CAM) |
| | | | MATERIAL | ITHE | APPLICATION | COMPONENT |
| * * * | | | STEEL | LAND | LAND VEHICLES | PROPULSION SYSTEM GEARS |
| | EFFORT NO | 0 • | SERVICE | YEARS OF FUNDING S | STATUS TITLE | u u |
| k k | 0 8053 | ~ 1 | ARMY | 7.7 | CAD/ | CAD/CAM FOR MANUFACTURE |
| | | | MATERIAL | APPLI | APPLICATION | COMPONENT |
| | 1 1 1 | ! ! ! | STEEL | SUPPORT | RT EQUIPMENT | PARACHUTE |
| 3 | EFFORT NO | ON F | SERVICE | YEARS OF FUNDING S | STATUS TITLE | ш |
| | 6 7586 | 49 | ARMY | 7.7 | ROTARY | RY FORGE INTEGRATED PRODUCTION TECHNOLOGY |
| | | | MATERIAL | I HOOF | APPLICATION | COMPONENT |
| k K | | | STEEL | S C C C C C C C C C C C C C C C C C C C | න ද | LARGE CALIBER |
| ĺ | | | | | | TUBES |

| # # | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | JS TITLE | | |
|----------|-----------|---|--|----------|--------------------------------------|---------------------------------|
| * . | | ARMY | 11 | IMPLE | IMPLEMENTATION OF THE B INCH XM20 | INCH XM201 ON ROTARY FORGE LINE |
| | | MATERIAL | APPLICATION | N O | COMPONENT | SPECIFIC PROCESS |
| | | | WEAPONS LARGE CALIBER | | LARGE CALIBER Tubes | FORGING, ROTARY |
| | EFFORT NO | 1 | YEARS OF STATUS | IS TITLE | | |
| 4 | 6 7726 | ₹ | 7 7 7 4 9 4 9 4 9 4 9 4 9 9 9 9 9 9 9 9 | APPLI | APPLICATION OF COLD AND WARM FURGING | 9 Z Z |
| | | MATERIAL | APPLICATION | NO. | COMPONENT | SPECIFIC PROCESS |
| | | STEEL. | E E A P O N G | | LARGE CALIBER Tubes, Thin Walled | FORGING, ROTARY |
| | EFFORT NO | | YEARS OF FUNDING STATUS | Ø | | |
| * | 6 7727 | A & & & & & & & & & & & & & & & & & & & | 79 | RECYCI | RECYCLING OF SCRAP GUN TUBES BY R | ROTARY FORGING |
| ; | | MATERIAL | APPLICATION | NO. | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | FEAPONG | | LARGE CALIBER Tubes | FURGING, ROTARY |
| | EFFORT NO | SERVICE | 2 | 1 | | |
| * * | 6 7985 | ₽ ₽₽ | 06 | SMALL | ARIO HEAPONG NEW PROCESS | PRODUCTION TECHNOLOY |
| • | | MATERIAL | APPLICATION | NO | COMPONENT | SPECIFIC PROCESS |
| k . | | STEEL | SECT AND SECTION OF SE | | CAL SO THRU 40MM BARRELS | FORGING, ROTARY |

| * | EFFORT ND | SERVICE | YEARS OF Funding Status | TITLE | | | |
|---------------|--------------------------------------|--------------|-------------------------------|---------|---|--|----------|
| * | 114102 | AIR FORCE | 21 3 80 6 0 | MF FOR | FOR THERMAL-MECHANICAL PROCESSING OF LOW COBALT ALLOYS | ING OF LOW COBAL | T ALLOYS |
| ; | | MATERIAL | APPLICATION | _ | COMPONENT | SPECIFIC PROCESS | • |
| | | SUPERALLOY | LOY AIRCRAFT TURBINE ENGINE | | TURBINE ENGINES | CONTROLLED DEFORMATION HEAT TREATMENT | RMATION |
| | EFFORT ND | | YEARS OF FUNDING STATUS | TITLE | | | |
| | 92M252 | AIR FORCE | 79 81 | MT FOR | MI FOR INTEGRAL ROTATING COMPONENTS BY ISOTHERMAL FORGING | IS BY ISOTHERMAL | FORGING |
| , | | MATERIAL | APPLICATION | | COMPONENT | SPECIFIC PROCESS | • |
| | 0 0 0 0 0 0 0 0 | SUPERALLOY | MISSILES | | OLORDINE ENGINES | FORGING, ISOTHERMAL | RAAL |
| | EFFORT ND | SERVICE | YEARS OF Funding | TITLE | | | |
| | 00700¥NQ | > 4 2 | 0 | RARE EA | EARTH ADDITIONS TO TITANIUM ALLOYS | 111078 | |
| ; | | MATERIAL | APPLICATION | _ | COMPONENT | SPECIFIC PROCESS | • |
| | | TITANIUM | AIRCRAFT | | AIRCRAFT STRUCTURES | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | TITLE | | | |
| t t k 4 | 1111122 | AIR FORCE | 81 | LOM COS | LOW COST TITANIUM WROUGHT PRODUCTS | • | |
| : | | MATERIAL | APPLICATION | _ | COMPONENT | SPECIFIC PROCESS | • |
| | | TITANIUM | AIRCRAFT | | | | |

FORGING

| * : | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
|-----|---|-----------|------------------|-------------|---|--|------------------|---------------------|
| | 714233 | AIR FORCE | 80 7.7 7.9 | 2 | F C C C C C C C C C C C C C C C C C C C | MT FOR PRODUCIBILITY OF HIGH TEMP TI ALLOY FRENCH CONNECTION | ALLOY | FRENCH CONNECTION |
| | | MATERIAL | ĕd∀ | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | XDIZVIN 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 | | AIA | AIRCRAFT | | AIRCRAFT TURBINE ENGINES DIOKS | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | 714231 | AIR FORCE | 77 78 | | MT FOR | MT FOR ISOTHERMAL FORGING FAN BLADES | | |
| | | MATERIAL | 44 ₹ | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | | HITANICE | AIA | AIRCRAFT | | TITANIUM AIRCRAFT TURBINE ENGINES FOI FOI | RGING, | FORGING, ISOTHERMAL |
| 1 | | | | • | 1 | | | |

FORGING

SUBCOMMITTEE ACCOMPLISHMENTS

- **ESTABLISHED A JOINT ARMY/AIR FORCE PROGRAM FOR ISOTHERMAL FORGING OF INTEGRAL ROTATING** COMPONENTS
- **DESTABLISHED A JOINT NAVY/AIR FORCE PROGRAM FOR FTRIUM ADDITIONS TO TITANIUM**

FUTURE SUBCOMMITTEE ACTIVITIES

- INVESTIGATE THE POSSIBILITY OF A JOINT NAVY/AIR FORCE PROGRAM FOR SCALE UP OF CORONA
- INVESTIGATE THE POSSIBILITY OF A JOINT NAVY/AIR FORCE PROGRAM ON NEW MANUFACTURING **TECHNOLOGY FOR SMALL ARMS WEAPONS**

ESTABLISHING A JOINT ARMY/AIR FORCE PROGRAM FOR ISOTHERMAL FORGING OF INTEGRAL ROTATING COMPONENTS. ALSO, A JOINT NAVY/AIR FORCE PROGRAM DURING THE PAST YEAR THE SUBCOMMITTEE HAS BEEN RESPONSIBLE FOR FOR YTTRIUM ADDITIONS TO TITANIUM WAS ESTABLISHED.

COMMITTEE WILL INVESTIGATE THE POSSIBILITY OF A JOINT ARMY/AIR FORCE PROGRAM IN THE NEXT YEAR, THE SUBCOMMITTEE WILL INVESTIGATE THE POSSIBILITY OF A JOINT NAVY/AIR FORCE PROGRAM FOR SCALE UP OF CORONA 5. ALSO, THE SUB-ON NEW MANUFACTURING TECHNOLOGY FOR SMALL ARMS WEAPONS.

FIVE YEAR FUNDING FORECAST

■ 32-36 MILLION

COMPARISON OF FIVE YEAR PLANS

2/////2

\$ **////**

78-82

FISCAL YEARS

79-83

81-85

80-84

16%

16%

COMPARISON OF INDIVIDUAL YEAR PROGRAMS

15%

4%

28

79

8

~

FISCAL YEAR

BETWEEN 32 TO 36 MILLION DOLLARS. THE FIVE YEAR PLAN COMPARISON SHOWS WE, THEREFORE, PROJECT THAT CASTING EFFORTS WILL CONTINUE TO REPRESENT IN THE CASTING AREA, WE ARE PROJECTING FIVE YEAR EXPENDITURES OF A CONSTANT LEVEL OF EFFORT AS DUES THE INDIVIDUAL YEAR COMPARISONS. ABOUT 15 PERCENT OF THE METALS PROGRAM.

TECHNICAL OBJECTIVES

- REDUCE THE "ART" FACTOR
- REDUCE CASTING FACTOR
- REDUCE REJECTION RATE
- IMPROVE MATERIAL UTILIZATION
- INCREASE DEGREE OF AUTOMATION
- OBTAIN REALISTIC DESIGN ALLOWABLE DATA

- 354,584 *-

REDUCE THE ART FACTOR, REDUCE THE CASTING FACTOR, REDUCE THE REJECTION RATE, IMPROVE MATERIAL UTILIZATION, INCREASE THE DEGREE OF AUTOMATION THE TECHNICAL OBJECTIVES BEING SOUGH! IN THE CASTING AREA ARE TO AND OBTAIN REALISTIC DESIGN ALLOWABLE DATA.

FREQUENCY SPECIFIC PROCESS

CASTING, CENTRIFUGAL CASTING, DIE CASTING, INVESTMENT CADCAM MOLD DESIGN CAST PLUS HIP ALLOY MIXING

CASTING, PRECISION CASTING, SQUEEZE CASTING, THIN WALL

DATA GENERATION DIRECTIONAL SOLIDIFICAT,

ESR SHAPED CASTINGS

INGOT SCALE UP EXOTHERMIC

NO-BAKE SANDS RHEOCASTING **NNOCULANTS**

WITHDRAWAL

THE TYPES OF CASTING PROCESSES BEING PURSUED AND THE NUMBER OF PROJECTS PURSUING THOSE PROCESSES ARE SHOWN ON THIS CHART.

FY 81 PROGRAM REVIEW

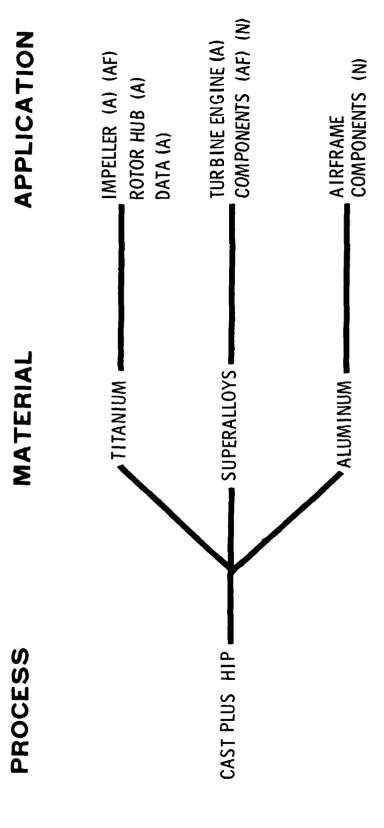
■ 13 PROJECTS REVIEWED

COMMON AREAS IDENTIFIED

CAST PLUS HIP

PRECISION CASTING

THE SUBCOMMMITTEE REVIEWED 13 FY81 PROJECTS. WE IDENTIFIED CAST PLUS HIP AND PRECISION CASTING AS COMMON AREAS AMONG THE SERVICES.



I'HE ARMY AND AIR FORCE ARE JOINTLY PURSUING CAST PLUS HIP TECHNOLOGY FOR COPTER ROTOR HUBS WHICH ARE MUCH LARGER AND USE A DIFFERENT ALLOY. THE ARMY CAST PLUS HIP MATERIALS. THIS IS AN EFFORT THAT WAS RECOMMENDED BY INDUSTRY IURBINE ENGINE IMPELLERS. THE ARMY IS ALSO USING THIS TECHNOLOGY FOR HELI-IS ALSO FUNDING AN EFFORT TO ESTABLISH A DESIGN DATA HANDBOOK FOR TITANIUM PARTICIPANTS AT THE METALS SUBCOMMITTEE'S CASTING SYMPOSIUM. THE NAVY AND AIR FORCE ARE JOINTLY PURSUING CAST PLUS HIP TECHNOLOGY FOR PRODUCING PREMIUM QUALITY SUPERALLOY CASTINGS. THE ARMY'S FY81 PROGRAM PROPOSES TO EXTEND LOW CYCLE FATIGUE PROPERTIES OF THESE CASTINGS. THE THREE SERVICES WILL MEET DURING THE COMING YEAR TO MAKE SURE THAT THESE EFFORTS WILL NOT DUPLICATE ONE ANOTHER. THE NAVY PROPOSES TO APPLY CAST PLUS HIP TECHNOLOGY TO ALUMINUM CASTINGS. THE AIR FORCE HAS EXPRESSED INTEREST IN THIS APPROACH AND MAY JOIN THE NAVY IN THIS PROGRAM.

PROCESS

MATERIAL

APPLICATION

■ MONOCRYSTAL BLADES (AF) (N) SUPERALLOY, PRECISION CASTING

DS BLADES (AF) (N)

THE NAVY AND AIR FORCE WILL INVESTIGATE THE POSSIBILITY OF JOINTLY FUNDING A PRECISION CASTING EFFORT FOR MONOCRYSTAL BLADES.

THE NAVY WILL APPLY COMPUTER TECHNOLOGY TO THIS PROCESS TO PRODUCE AN THE AIR FORCE ESTABLISHED THE RAM-DS PROCESS IN A PRIOR PROGRAM, ADAPTIVELY CONTROLLED PROCESS. THE SUBCOMMITTEE DETERMINED THAT NO DUPLICATION EXISTS,

8 NEW PROJECTS REVIEWED

FY80 PROGRAM CHANGES REVIEW

- COMMON AREAS IDENTIFIED
- NO NEW AREAS

COMMON AREAS THAT HAD NOT BEEN ALREADY IDENTIFIED IN THE REVIEW OF THE THE SUBCOMMITTEE REVIEWED EIGHT NEW FY80 PROJECTS AND FOUND NO NEW FY81 PROJECTS. APPORTIONMENT, AND BUDGET PROJECTS WHICH HAVE BEEN CLASSIFIED AS CASTING. THE PROJECTS ARE SORTED BY THE MATERIAL BEING CAST AND ITS APPLICATION.

THE FOLLOWING COMPUTER PRINTOUT CONTAINS THE DATA FOR ALL ACTIVE,

| STATUS | * | | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|---|-------|------------------|----|-----------|---------------------|------------|------------------|--------------------------|---|
| STATUS STATUS CRAFT SILES STATUS STATUS STATUS TCATION TCATION TCATION TCATION TCATION | * | DNA00744 | 77 | NAVY | 90 | 2 | HIP OF | AIP OF ALUMINUM CASTINGS | |
| STATUS NU LICATION CRAFT SILES STATUS STATUS STATUS OTATUS OTATUS NITION | * | | | MATERIAL | ¥ | PLICATION | | COMPONENT | SPECIFIC PROCESS |
| STATUS LICATION CRAFT SILES STATUS STATUS STATUS ICATION ICATION ICATION | . ! | , , , , | | ALUMINUM | I V | ACRAFT | | AIRFRAME PARTS | CAST PLUS HIP |
| CRAFT SILES STATUS STATUS STATUS TCATION ICATION | 4 | | Ş | SERVICE | YEARS OF FUNDING | STATUS | 7776 | | |
| CRAFT SILES STATUS STATUS STATUS STATUS DICATION | * | | | AIR FORCE | 0 | צכ | MT FOR | PROCESS EFFECTS ON | MI FOR PROCESS EFFECTS ON ALUMINUM CASTING ALLOWANTED |
| STATUS STATUS STATUS STATUS STATUS STATUS | * | | | MATERIAL | APP | LICATION | | COMPONENT | |
| STATUS ICATION ICATION | • • • | | | | į | ⊢ Ø | | STRUCTURES | |
| ICATION STATUS STATUS | * | EFFORT | 0 | SERVICE | ø ∺ | 80. | TITLE | | |
| STATUS STATUS STATUS NITION | * | 91 4268 | | | 79 | | MT FOR | PROCESS EFFECTS ON | ALCHINCH ALLOHABIES |
| STATUS STATUS ICATION | * | | | MATERIAL | APP | LICATION | | COMPONENT | |
| STATUS ICATION NITION | . ! | | į | ALUMINUM | AIR | CRAFT | : : : : | AIRFRAME COMPONENTS | |
| ICATION | * | EFFORT N | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| ICATION | * * | 5 1903 | | ¥ E | 949 | | DIE CAS' | T TAILCONE AND DESIG | DIE CAST TAILCONE AND DESIGN HACHINE FOR BLU-96/8 |
| NITION | * | | | MATERIAL | 1444 | .ICATION | J | TOMPONENT | SPECIFIC PROCESS |
| | ! | | | ALUMINUM | JMMA | NITION | ~ | BOM6 Tail cone | CASTING, DIE |

| # | | 14 1- 20 14 87 | YEARS OF | A + 0 | <u>.</u> | | |
|-----|---------------------------------|----------------------------|--|------------------|----------|---|---|
| * * | T 5080 | ARMY | 7.0 |) - - - | FABRICA | TION METHODS FOR HIGH STRE | FABRICATION METHODS FOR MIGH STRENGTH NET SHAPE ALUMINUM TRANSMISSION CASES |
| • | | | © | | | | |
| ; | | MATERIAL | ₹d v | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | ALUMINUM | LAND | ND VEHICLES | : | SANDAINOUZONAMA CAOMO | CAST PLUS HIP |
| ; | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 02H17S | AIR FORCE | 0 4 | 3 | MT FOR | MT FOR HIGH DUCTILITY ALUMINUM CABTINGS | BIINGB |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | ALUMINUM | | MISSILES | | GARCALURGO | |
| | EFFORT NO | SERVICE | YEARS OF Funding | TATU | TITLE | | |
| | 714174 | AIR FORCE | 78 77 79 | | MT FOR | MT FOR WROUGHT FABRICATION METHODS FOR TI ALUMINIDE | S FOR TI ALUMINIDE |
| ; | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | DTHER | AII | AIRCRAFT | | TURBINE ENGINES | INGOT SCALE UP |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | 7 I TE | | |
| | DN800 673 | *** | 00 | 2 | BATTER | BATTERY GRID CASTING | |
| : | | MATERIAL | AP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | 0 0 0 0 0 0 0 | OTHER | 三五の 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 9H1P0 | | OTHER GRIPS SATTERIES SUBSARINES | |

| t 1 | , | | YEARS OF | | | | | |
|--------|---|----------|--|----------------------------|---------|--|-------------------------------------|--|
| • | EFFORT NO | SERVICE | FUNDING | STATUS | TITLE | | | |
| | T 5006 | A A A | 44 | | PRODUC | PRODUCTION OF LIGHTWEIGHT STE | STEEL CAST TRACK S | SHOES |
| * | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC | PROCESS |
| | 0 | STEEL | | LAND VEHICLES | | TRACK GHOES | CASTING, 1 | THIN WALL |
| | EFFURT NO | SERVICE | VEARS OF FUNDING | STATUS | TITLE | | | |
| | 1 4586 | ARM Y | 9 4 | | IMPROVE | IMPROVED LARGE ARMOR STEEL CA | CABILLES | |
| : | | MATERIAL | ď | APPLICATION | | COMPONENT | SPECIFIC P | PROCESS |
| * * * | # # # # # # # # # # # # # # # # # # # | 9TEEL | | LAND VEHICLES | : | 10RKET | CONDUCTIVE INNOCULANTS CHILLS | ○ 2 ∀ 0 0 |
| : | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| * * * | T 5002 | **** | 44 | | FABRICA | FABRICATING TORSION BAR SPRING | TO TOIT MORE BOXINGO | STRENGTH STEEL |
| * | | MATERIAL | V | APPLICATION | | COMPONENT | SPECIFIC PROCESS | RDCESS |
| | | STEEL | | LAND VEHICLES | | TORSION BARS | M > 82 4 87 87 | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | 7LE | | | |
| * * | T 50 92 | A 28 × | 69 18.2 | | RHEOCAS | RMEOCAST PRESSURE CASTING FOR COMBAT VEHICLE | COMBAT VEHICLE | 8 ► 8 + 8 + 8 + 8 + 8 + 8 + 8 + 8 + 8 + 8 |
| 4 | | MATERIAL | #d∀ | APPLICATION | _ | COMPONENT | SPECIFIC PR | PROCESS |
| * * | | STEEL | LAN | LAND VEHICLES | | END CONNECTORS | RMEDCASTING | (9. |
| . ! | | | X) = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 8 9 9 1 1 8 | | TRACK SHOES | THIXDFORGIN | ن ع |

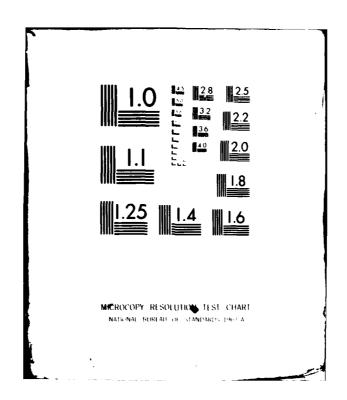
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|-----------|---------------------------------------|--|--|---|
| EFFORT NO | SERVICE PREVICE | YEARS OF FUNDING STATUS 80 79 | TITLE CMEMICALLY BONDED SAND FOR | SAND FOR CLOSE TOLERANCE |
| | MATERIAL | APPLICATION MEAPONS | COMPONENT GUN MOUNTS | SPECIFIC PROCESS MOLD MAKING NO-BAKE WANDS |

| # : | EFFORT NO | 2 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|---------------|------------------|---|------------|---|-------------|------------|--|--------------------------|
| * | 9508 9 | | ARMY | 0 | | RECYCL) | RECYCLING SPENT GUN TUBES BY ESR MELTING | MELTING |
| | | | MATERIAL | APP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | • | STEEL | 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | MEAPONS | 1 | WEAPONS CANNON TUBES | CK. 803 Udi |
| | EFFORT NO | Q | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| # # # | 6 8117 | | Y 2 2 4 | 10 | | SHAPED | CASTINGS OF ESP STEEL | |
| • | | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | 8 8 8 8 | | STEEL | S N D D A D D N O | E A PONG | | BARECH BLOCKS BARECH AIVOS | EGR SHAPED CASTINGS |
| | EFFORT NO | | | YEARS OF Funding | STATUS | TITLE | | |
| # # # # | DNA81059 | • | > V | 91 | | CAM RAM-DS | 9Q-1 | |
| | | | MATERIAL | Ϋ́Þ | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | SUPERALLOY | | AIRCRAFT | | TURBINE ENGINES TURBINE BLADES | DIRECTIONAL SOLIDIFICAT, |
| | EFFORT NO | 0 | SFRVICE | YEARS UF FUNDING | STATUS | TITLE | | |
| | ENA00746 | ٥ | NAVY | 0 | | B 1911 | HIGH STRENGTH INCO 718 CASTINGS | |
| | | | MATERIAL | APP | APPLICATIUN | | COMPONENT | SPECIFIC PROCESS |
| | | | SUPERALLOY | 3 | AIRCRAFT | 1 | AIRCRAFT IMPELLER | QUALITY CONTROL |

| EFFURT NO | SERVICE | FUND INC | 91A10 | TITLE | |
|---|--------------|---|-------------|---|---------------------|
| 01#121 | AIR FORCE | O (V) | | PAEMIUN TURBINE MMEEL CASTINGS | |
| | MATERIAL | Jeda | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | SUPERALLOY | | AIRCRAFT | TURBINE ENGINES STATIC COMPONENTS ROTATING COMPONENTS | CA87126 |
| EFFURT 40 | SERVICE | YEARS OF FUNDING | STATUS | 7174.6 | |
| 1 7300 |)- 3 4 | 88 8.2 8.2 8.3 | | IMPRUVED LOM CYCLE FATIGUE CAST | ROTORS |
| | MATERIAL | 1664 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | SUPERALLOY | AIRC | AIRCRAFT | TURBINE ENGINES | CAST PLUS HIP |
| | | *************************************** | ; ; ; | ROTURG | HEAT TREATMENT |
| EFFORT NO | SERVICE | YEARS OF FU1014G | STATUS | 1111.6 | |
| CNA81062 | ×> 4 2 | 91 | | MONOCRYSTAL TURNINE AIRFOILS | |
| | MATERIAL | APPL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | 3nbE4VLL0Y | AIRC | AIRCRAFI | TURBINE BLADES TURBINE ENGINES | |
| EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | | |
| # T T T T T T T T T T T T T T T T T T T | AIR FORCE | 79 09 √ 10 00 ≈ | 5 | MT FOR HP OS FUTECTIC BLADE FABRICATIO! | RICATIO14 |
| | MATERIAL | 10d▼ | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | зор£кат ∟ох | AIRCRAFT | RAFT | TURBINE ENGINES | CASTING, INVESTMENT |

| 82M143 82M143 62M143 67F0RT NO | SERVICE AIR FORCE MATERIAL SUPERALLOY SERVICE NAVY | M | APPLICATION MISSILES STATUS | 717LE 717LE 717LE | HIGH INTEGRITY CAST TURBINE ENGINES DIFFUSER DIFFUSER TITANIUM | OIFFUSER FOR SMALL ENGINES Specific Process Casting, precision |
|--------------------------------|--|--|-----------------------------------|-------------------------|--|--|
| 7 | MATERIAL TITANIUM | 4 4 G G G G | APPLICATION AIRCRAFT | 3 | COMPONENT MICS HARDWARE | SPECIFIC PROCESS ALLOY MIXING |
| | SERVICE ARMY | 7 E A A B B B B B B B B B B B B B B B B B | STATUS | 717LE HOT 180 | TITLE HOI ISUSTATIC PRESSED TITAN | PRESSED TITANIUM CASTINGS |
| • | MATERIAL TITANIUM | q 4 € 8 | APPLICATION AIRCRAFT | | COMPONENT ROTOR HUB | SPECIFIC PROCESS CAST PLUS HIP |
| | SERVICE ARMY | 76 A B C C C C C C C C C C C C C C C C C C | STATUS SUCT | TITLE | 8 0 8 | IMPELLAR |
| | MATERIAL | A | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | MUINATIT | A I A | AIRCRAFT | | TURBINE ENGINES COMPRESSOR IMPELLARS | S CAST PLUS HIP |

AD-A085 756 ARMY INDUSTRIAL BASE ENGINEERING ACTIVITY ROCK ISLAND IL F/6 11/6 METALS SUBCOMMITTEE REPORT - MANUFACTURING TECHNOLOGY ADVISORY --ETC(U) JAN 80 G NEY UNCLASSIFIED NL 2..4 AF TAL



| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|-----------------|---------------------------------------|-----------------------|---|-------------|-------------|---|-----------------------|
| * * | 1 7070 | A 2 3 4 | 75 | | CAST COMP | CAST COMPRESSOR COMPONENTS | |
| : | | MATERIAL | APPL1 | APPLICATION | 0 | COMPONENT | SPECIFIC PRUCESS |
| : | | TITANIUM | NIUM AIRCRAFT TURBINE ENGINE COMPRESSOR | 1AFT | 7 CO | TURBINE ENGINES COMPRESSOR | CAST PLUS HIP |
| | EFFORT ND | | YEARS OF FUNDING | STATUS | TITLE | | |
| # # # * | 1 7046 | ARBY | 7.7 | | PRECISION | PRECISION CAST TITANIUM COMPRESSOR CASING | REGOOD CAGING |
| | | MATERIAL | APPLI | APPLICATION | 00 | COMPONENT | SPECIFIC PROCESS |
| # # # # . | | TITANIUM | AIRCRAFT | 1AFT | J. | TURBINE ENGINES | |
| ! | 9 9 9 9 9 | 0 0 0 0 0 | | | 00 | COMPRESSOR | CABILLES CENTRIFICENT |
| | EFFURT NO | SERVICE | YEARS UF FUNDING | STATUS | TITLE | | |
| * | 1 7362 | ₹ | 18 18 | | engineering | NG DESIGN HANDBOOK FOR | FOR TITANIUM CABTINES |
| | | MATERIAL | APPL 1 | APPLICATION | 00 | COMPONENT | SPECIFIC PROCESS |
| * | | TITANIUM | AIRCRAFT | IAFT |) (1) | TURBINE ENGINES | DATA GENERATION |
| ! | • • • • • • • • • • • • • • • • • • • | | TARD ARANTA CONTRACTOR OF THE STREET OF THE | ILES | F3 M | ALATAAN COMPONENTO ALATAAN COMPONENTO | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 024163 | AIR FORCE | 0 0 | 2 | MT FOP LA | MT FOP LARGE TITANIUM INLET CASTINGS | 997H-841 |
| | | MATERIAL | APPLI | APPLICATION | 8 | COMPONENT | SPECIFIC PROCESS |
| * * | | TITANIUM | BINOSIE | LES | 10 | STRUCTURES | PRECISION CASTING |
| | | | | | | | |

| * | EFFORT NO | 0 | SERVICE | YEARG OF FUNDING | STATUS TITLE | TITLE | |
|-----|-----------|---|-----------|---------------------|--------------|---|---|
| * * | 02M151 | | AIR FORCE | 700 | | MT FOR CAST TITANIUM COMPRESSOR ROTOR | |
| 4 | | | MATERIAL | AP | APPLICATION | COMPONENT SPECIFIC PROCESS | • |
| | | | TITANIUR | 114 | HIBBILES | TURBINE ENGINES COMPRESSOR IMPELLER CAST | |

**

SUBCOMMITTEE ACCOMPLISHMENTS

DESTABLISHED JOINT NAVY/AIR FORCE PROGRAM FOR PREMIUM SUPERALLOY CASTINGS

FUTURE SUBCOMMITTEE ACTIVITY

- DINVESTIGATE POSSIBILITY OF JOINT NAVY/AIR FORCE PROGRAM FOR MONO-CRYSTAL AIR FOILS
- INTEGRATE ARMY PROGRAM FOR LCF PROPERTY IMPROVEMENT WITH JOINT NAVY/AIR FORCE PROGRAM FOR PREMIUM SUPERALLOY CASTINGS
- DINVESTIGATE POSSIBILITY OF JOINT NAVY/AIR FORCE PROGRAM FOR HIP ALUMINUM

DURING THE PAST YEAR THE SUBCOMMITTEE HAS BEEN RESPONSIBLE FOR ESTABLISHING A JOINT NAVY/AIR FORCE PROGRAM FOR PREMIUM SUPERALLOY CASTINGS.

POSSIBILITY OF A JOINT NAVY/AIR FORCE PROGRAM FOR HIP ALUMINUM CASTINGS. IN THE NEXT YEAR, THE SUBCOMMITTEE WILL INVESTIGATE THE POSSIBILITY OF A JOINT NAVY/AIR FORCE PROGRAM FOR MONOCRYSTAL AIR FOILS. THE SUB-COMMITTEE WILL INTEGRATE THE ARMY PROGRAM FOR LCF PROPERTY IMPROVEMENT TO ENSURE NO DUPLICATION. THE SUBCOMMITTEE WILL ALSO INVESTIGATE THE WITH THE JOINT NAVY/AIR FORCE PROGRAM FOR PREMIUM SUPERALLOY CASTINGS

POWDER METALLURGY

FIVE YEAR FUNDING FORECAST

● 19-23 MILLION

COMPARISON OF FIVE YEAR PLANS

95

**** 2////

\$ **///**

79-83

78-82

FISCAL YEARS

80-84

81-85

18%

COMPARISON OF INDIVIDUAL YEAR PROGRAMS

FISCAL YEAR

IN THE POWDER METALLURGY AREA, THE FIVE YEAR FUNDING FORECAST PROJECTS WHEREAS THE COMPARISON OF INDIVIDUAL YEAR PROGRAMS SHOWS A HIGHER CONSTANT EXPENDITURES OF 19 TO 23 MILLION DOLLARS. A DOWNWARD TREND THAT APPEARS TO BE LEVELING OFF IS INDICATED BY THE COMPARISON OF THE FIVE YEAR PLANS LEVEL OF EFFORT, THE DIFFERENCE BETWEEN THE TWO WOULD INDICATE THAT THE POWDER METALLURGY EFFORT WILL BE DECREASING IN THE FUTURE.

POWDER METALLURGY

TECHNICAL OBJECTIVES

- B REFINE PROCESS PARAMETERS
- OBTAIN BETTER MATERIAL UTILIZATION
- OBTAIN HIGH UNIFORM DENSITY AND PROPERTIES
- MEET UNIQUE PERFORMANCE REQUIREMENTS
- B REDUCE TOOLING AND PROCESSING COSTS

ARE TO REFINE THE PROCESSING PARAMETERS, OBTAIN BETTER MATERIAL UTILIZATION, THE TECHNICAL OBJECTIVES BEING SOUGHT IN THE POWDER METALLURGY AREA OBTAIN HIGH UNIFORM DENSITY AND PROPERTIES, MEET UNIQUE PERFORMANCE REQUIREMENTS, AND REDUCE TOOLING AND PROCESSING COSTS.

| SPECIFIC PROCESS AREA | EXTRUSION PREFORMS HOT ISOSTATIC PRESSING | ISOSTATIC PRESSING ISOTHERMAL FORGING | OTHER (PM APPROACH) | PM FORGING PREP | PRESS AND SINTER | POWDER MANUFACTURE | TARDONA, VACUUM HO |
|--------------------------|---|---------------------------------------|---------------------|--------------------|------------------|--------------------|--------------------|
| FREQUENCY | 12 | - | (| m – | 2 | 2 | |

THIS CHART SHOWS THE PROCESSES BEING WORKED ON IN THE POWDER METALLURGY AREA AND THE NUMBER OF PROJECTS PURSUING EACH SPECIFIC PROCESS.

FY 81 PROGRAM REVIEW

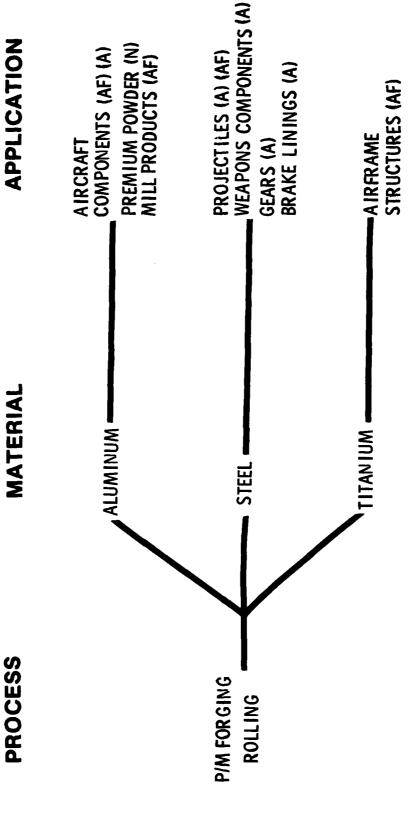
■ 12 PROJECTS REVIEWED

COMMON AREAS IDENTIFIED

P/M FORGING/ROLLING

HOT ISOSTOTIC PRESSING

THE SUBCOMMITTEE REVIEWED 12 FY81 PROJECTS. WE IDENTIFIED P/M FORGING/ROLLING AND HOT ISOSTATIC PRESSING AS COMMON AREAS.



PRESS ALUMINUM AIRCRAFT STRUCTURAL COMPONENTS. THE NAVY IS PROPOSING TO SCALE-UP THE PRODUCTION OF PREMIUM ALUMINUM POWDER AND THE AIR FORCE IS THE ARMY AND AIR FORCE ARE JOINTLY FUNDING AN EFFORT TO VACUUM HOT PROPOSING TO SCALE-UP ARMY ESTABLISHED PROCESSES FOR MAKING ALUMINUM MILL PRODUCTS.

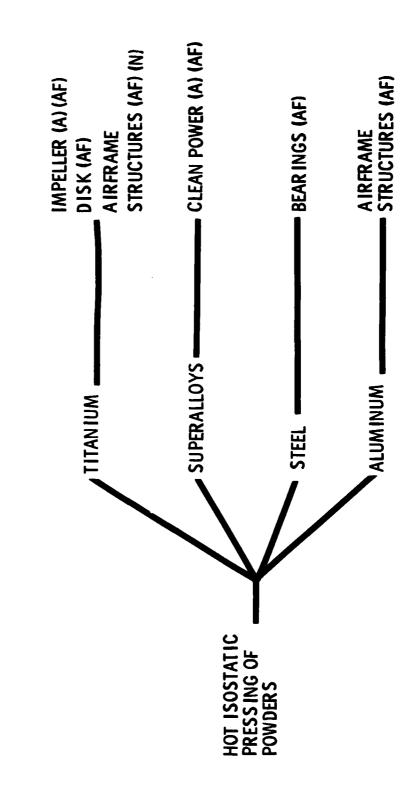
DISINTEGRATE UPON IMPACT. THE REST OF THE STEEL P/M WORK IS FUNDED BY THE ARMY'S STEEL PROJECTILE WORK ESTABLISHED A PROCESS FOR MAKING 100 PERCENT DENSE MORTAR ROUNDS WHEREAS THE AIR FORCE IS ESTABLISHING PROCESSES TO MAKE PARTIALLY DENSE TARGET PRACTICE ROUNDS WHICH WILL THE ARMY.

THE AIR FORCE HAS ESTABLISHED VACUUM HOT PRESSING OF TITANIUM AIRFRAME STRUCTURES.

APPLICATION

MATERIAL

PROCESS



NAVY AND AIR FORCE ARE JOINTLY FUNDING AN EFFORT TO APPLY HOT ISOSTATIC THE ARMY AND AIR FORCE ARE JOINTLY ESTABLISHING THE HOT ISOSTATIC PRESSING PROCESS FOR MAKING TITANIUM TURBINE ENGINE IMPELLERS. THE PRESSING TO TITANIUM AIR FRAME STRUCTURES.

THE ARMY AND AIR FORCE ARE ESTABLISHING PROCESSING PARAMETERS FOR MAKING CLEAN SUPERALLOY POWDERS.

FY80 PROGRAM CHANGES REVIEW

1 NEW PROGRAM CHANGES REVIEWED

OCOMMON AREAS IDENTIFIED

ONO NEW AREAS

THEY HAVE BEEN SORTED BY THE MATERIAL BEING PROCESSED AND THE APPLICATION COMMON AREAS THAT HAD NOT BEEN IDENTIFIED IN THE REVIEW OF FY81 PROJECTS. THE SUBCOMMITTEE REVIEWED SEVEN NEW FY80 PROJECTS AND FOUND NO NEW THE FOLLOWING COMPUTER PRINTOUT CONTAINS ALL ACTIVE, APPORTIONMENT AND BUDGET PROJECTS WHICH HAVE BEEN CLASSIFIED AS POWDER METALLURGY. TO WHICH IT IS BEING APPLIED.

| | | SPECIFIC PROCESS | | | ON SCALE-UP | SPECIFIC PROCESS | | | | SPECIFIC PROCESS | FORGING Extrusion | | | SPECIFIC PROCESS | PH FORGING |
|------------------|-------------------------|------------------|------------------------|---------------------|--|------------------|-----------------------------|---------------------|---------------------------------|------------------|----------------------------|---------------------|------------------------------|------------------|--|
| W | PREMIUM ALUMINUM POWDER | COMPONENT | AIRCRAFT MISC HARDWARE | u -i | MT FOR PH ALUMINUM PLATE PRODUCTION SCALE-UP | COMPONENT | ALUMINUM AIRCRAFT GIACTURES | w L | PM ALUMINUM LONGERON COMPONENTS | COMPONENT | ALUMINUM AIRCRAFT LONGERON | - Lat | PRECISION FORGED ALUMINUM PM | COMPONENT | ALUMINUM AIRCRAFT AIRFRAME MISC COMPONENTS |
| TITLE | PRE | | | TITLE | F | | | TITLE | ď. | | | TITLE | PRE | | |
| STATUS | | APPLICATION | AIRCRAFT | STATUS | D. | APPLICATION | AIRCRAFT | STATUS | | APPLICATION | AIRCRAFT | STATUS | | APPLICATION | AIRCRAFT |
| YEARS OF FUNDING | 91 | API | A I | YEARS OF FUNDING | 6 60 | ν | IV | YEARS UF FUNDING | 82 | API | 1 | YEARS OF Funding | 7. 7.7 | API | I |
| SERVICE | > V | MATERIAL | ALUMINUM | SERVICE | AIR FORCE | MATERIAL | ALUMTNUM | SERVICE | AIR FORCE | MATERIAL | ALUMINUM | SERVICE | ¥ X X | MATERIAL | ALUMINUM |
| 9 | 7.8 | | | 9 | | | | Ü | | | |) 2 | | | |
| EFFORT NO | DNA81078 | | | EFFURT NO | 01#167 | | | EFFORT NO | 111121 | | | EFFURT NO | 1 7238 | | |
| * | * * | | | • | : | : | | ; | | ; | | | | | |

| * | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
|----------|-----------|-----------|--|---------------|----------|--|----------------------|----------------------------------|
| | 711169 | AIR FORCE | 90 | 2 | ALUMINUM | IN PH FOR PRECISION PARTS | 0 × 2 × 0 | |
| | | MATERIAL | APA | APPLICATION | | COMPONENT | SPECIFIC | SPECIFIC PROCESS |
| | | ALUMINUM | AIA | AIRCRAFT | | 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | HOT 1908 | HOT ISOSTATIC PRESSING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | 911116 | AIR FORCE | 9 4 9 0 | | H 16H 91 | HIGH STRENGTH PM ALUMINUM MILL | HILL PRODUCTS | |
| ; | | MATERIAL | dd. | APPLICATION | | COMPONENT | SPECIFIC | SPECIFIC PROCESS |
| | | ALUMINUM | A 18 | A1RCRAF1 | • | ALUAIN: AIRCRAFT GIRCLIUREG | PA FORGI EXTRUGIO | PH FORGING Extrusion preforms |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | 1116 | | | |
| R E . | 02H172 | AIR FORCE | 0 | 2 | HT FOR | MT FOR INJECTION MOLDED COLUMBIUM COMBUSTORS | LUMBIUM COMBUSTO | 6 |
| | | HATERIAL | 444 | APPLICATION | | COMPONENT | SPECIFIC | SPECIFIC PROCESS |
| | COLUME | | A TUREIN MISSIFES MOTIFES MOTIFIES MOTI | MI 99 IL E 8 | | TURBINE ENGINES COMBUSTOR | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | T 5007 | 7 2 2 | 70 | | ADVANCE | ADVANCED TECHNOLOGY BRAKE LINING MATERIALS | LINING MATERIALS | |
| | | HATERIAL | 84 | APPLICATION | | COMPONENT | SPECIFIC | SPECIFIC PROCESS |
| | IRON | IRON | LAR | LAND VEHICLES | • | LAND VEHICLES BRAKE LININGS | A SERBE | PRESS AND SINTER |

all principles of the said said said a

PUHDER METALLURGY

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|-----------------|-----------|---|---------------------|-------------|---------|---|---|
| : | 5 ••• 5 | A # # # # # # # # # # # # # # # # # # # | 7.6 7.7 | | PRODUCT | TION OF TUNGSTEN SASE ALLOY | PRODUCTION OF TUNGSTEN SASE ALLOY PENETRATORS FOR AP MUNITION |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| • | OTHER | OTHER | Z Z | AMMUNITION | | METAL PARTS PROJECTILE PENETRATORS | MOT ISOSTATIC PRESSING |
| | لما | SEHVICE | YEARS OF FUNDING | STATUS | 1176 | | |
| : . | DNS00587 | > 4 | 2 | | PONDER | POWDERED METAL SINTERING | |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | OTHER | OTHER | Ĭ | MISSILES | | MISSILES ROCKET MOTORS | |
| | EFFORT NO | SERVICE | YEARS UF FUNDING | STATUS | TITLE | | |
| • | 114103 | AIR FORCE | 9 6 | | MT FUR | MT FOR SCALE UP OF PM BEARING MATERIALS | FRIALS |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| : . i | 916E | STEEL | IV : | AIRCRAFT | | AIRCRAFT TURBINE ENGINES | HOT ISOSTATIC PRESSING |
| | EFFORT NO | SERVICE | VEARS OF Funding | STATUS | TITLE | | |
| # # # * * | 08#120 | ATR FORCE | 80 81 | | MT FOR | 20MM FRANGIBLE PROJECTILE FABRICATION | FABRICATION |
| | | MATERIAL | ٩٧ | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| e R | | STEEL | | AMMUNITION | | PROJECTILE FRANGIBLE | OTHER (PH APPROACH) |
| | | | | | | | |

| * | EFFORT NO | SERVICE | YEARS OF STATUS | 7.17 LE | |
|-----|---|-----------|---|--|------------------------|
| :. | 5 6211 | ARMY | | SINTERED STEEL PREFORMS FOR WORKING INTO FRAG SHELL BODIES | FRAG SWELL BODIES |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| Ē., | | STEEL | AMMUNITION | STADIO STATE STATES | EXTRUSION, COLO |
| ! | | _ | 9 | | |
| : | EFFORT NO | SERVICE | YEARG OF FUNDING STATUS | TITLE | |
| | 78M155 | AIR FORCE | 77 70 70 70 70 70 70 70 70 70 70 70 70 7 | MT FOR FRANGIBLE PROJECTILES | |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | # * * * * * * * * * * * * * * * * * * * | STEEL | NOILINDWWA | TARGET PROJECTIES | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | TITLE | |
| | 7 5063 | A 2 2 4 | 76 78 | UPSCALING OF ADVANCED POWDER METALLURGY PROCESSES | PROCESSES |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | LAND VEHICLES | 60 P.70 60 60 60 60 60 60 60 60 60 60 60 60 60 | ISUTHERMAL FORGING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | TITLE | |
| | 6 7926 | ¥ ₹ ₹ | 0 0 | HOT ISOSTATIC PRESSING OF LARGE ORDNANCE ! | ORDNANCE COMPONENTS |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | A STEEL B COTE EL COT | STEEL | OZOAVUE 111111111111111111111111111111111111 | MEAPONG BREECH BLOCKG MOT 1801 | HOT ISOSTATIC PRESSING |
| | | | | | |

| R R | | 1 | YEARS OF | | | | |
|---------|-----------|------------|---|-------------|----------------|---|--|
| : | EFFORT NO | SERVICE | S C C C C C C C C C C C C C C C C C C C | 81418 | TITLE | | |
| | 6 6102 | A A A | 0 60 1 60 1 60 | | APPLICATION OF | ION OF POWDER METALLURGY | POWDER METALLURGY FORGING WEAPONS COMPONENTS |
| 4 | | MATERIAL | Ā | APPLICATION | U | COMPONENT | SPECIFIC PROCESS |
| | 9 TEEL | | OZDQ VIII | FEAPONG | • | BRACKETS EXTRACTORS TIMES PINS | PM FORGING |
| | EFFURT NO | | YEARS OF FUNDING | STATUS | TITLE | | |
| R | 6 7649 | > 1 2 4 | 77 | | COMPUTER | COMPUTERIZED POWDER METALLURGY FORGING DESIGN-CAM | DRGING DEGIEN-CAR |
| | | MATERIAL | AP | APPLICATION | U | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | | MEAPONG | 9 | SMALL ARMS COMPONENTS | PM FORGING |
| ; | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| t. R | 6 8163 | > 1 C | | | P/M STEEL | PREFORMS FOR | SMALL CALIBER MEAPONS |
| | | MATERIAL | d | APPLICATION | U | CCHPONENT | SPECIFIC PROCESS |
| | | STEEL | 3 2 | *EAPONS | 6 0 | SEAPONS GOLTO | HOUSTAINC PARSOINS |
| | EFFORT NO | ı | YEARS UF FUNDING | STATUS | TITLE | | |
| | 71M186 | AIR FORCE | 37 77 81 | | MT FOR NEAR | EAR NET DISK SHAPE PRODUCTION | NOTES |
| : | | MATERIAL | API | APPLICATION | U | COMPONENT | SPECIFIC PROCESS |
| | | SUPERALLOY | | AIRCRAFT | -0 | TURBINE ENGINES DISKS | ē. M |

| : : | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | 1176 | | | |
|-----------------|---------------------------|--------------------------|---------------------|-------------|----------|--|------------------|-------------------------|
| · . | 011103 | AIR FORCE | 6 6 | | MT FOR | DR POWDER BLADES | | |
| 4 | | MATERIAL | Idv | APPLICATION | | COMPONENT | SPECIFIC | PROCESS |
| | 34 6.70 | SUPERAL! OY | | ALBCRAFT | | TURBINE ENGINES TORDINE TORDINE ENGINE ENGIN | GRADIENT MEATING | ie a ting |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | 01#130 | AIR FURCE | 0 11 (N M) | | MT FOR | MT FOR EFFECTS OF MANUFACTURING PROCESSES ON STRUCTURAL ALLOWABLES | PROCESSES OF | N STRUCTURAL ALLOMABLES |
| | | MATERIAL | idv | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | | OUPERALLOY A SOLVERALLOY | IV | AIRCRAFT | | AIRCRAFT AIRFRAMES | HOT 18081 | HOT ISOSTATIC PRESSING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| * | 02M103 | AIR FORCE | 0 0 0 0 0 0 | 2 | MT FOR | MT FOR ADVANCED SUPERALLOY PM FOR ROTATING COMPONENTS | R ROTATING | COMPONENTS |
| | | MATERIAL | ĄV | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| *** *3 A S C | *** *jasuperalloy * | AIRCRAFT | - | TURBINE | ENGINE S | 9349UPERALLOY AIRCRAFT TURBINE ENGINES HOT ISOSTATIC PROBLEM | PRESSING | |
| • | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | 114107 | AIR FORCE | • | | MT FOR | ROP DISKS WITH LCF LIFE | | |
| • | | MATERIAL | 14 | APPLICATION | | CCMPONENT | SPECIFIC PROCESS | PROCESS |
| | | SUPERALLOY | 114 | AIRCRAFT | | SUPERALLOY AIRCRAFT DISKS | HOT ISUST | HOT ISUSTATIC PRESSING |

| TITLE | HIGH GUALITY SUPERALLOY POWDER PRODUCTION FOR TURBINE COMPONENTS | COMPONENT SPECIFIC PROCESS | TURBINE TURBINE | | MT FOR PRODUCTION OF AN ADVANCED SUPERALLOY OUAL-PROPERTY TURBINE | COMPONENT SPECIFIC PROCESS | TURBINE ENGINES | | MT FUR IMPROVED SUPERALLOY POWDER PRODUCTION | COMPONENT SPECIFIC PROCESS | TURK COMPRESSOR | 7171.8 | MT FOR IMPROVED SUPERALLOY POWDER PRODUCTION | COMPONENT SPECIFIC PROCESS | D X D X D |
|---------------------|--|----------------------------|--------------------|--------------|---|----------------------------|-----------------|---------------------|--|----------------------------|-----------------|---------------------|--|----------------------------|------------|
| STATUS | | APPLICATION | | RS OF STATUS | | APPLICATION | AIRCRAFT | STATUS | | APPLICATION | AIRCRAFT | STATUS |) 2 | APPLICATION | AIRCRAFT |
| YEARS OF FUNDING | 9 4 9 | | | | 77 78 79 | • | | YEARS OF FUNDING | 80 | ∢ | | YEARG OF FUNDING | 90 | ∢ | |
| SERVICE | > 1 4 | MATERIAL | SUPERALLOY | SERVICE | AIR FORCE | MATERIAL | SUPERALLOY | SERVICE | AIR FORCE | MATERIAL | SUPERALLOY | SERVICE | AIR FORCE | MATERIAL | SUPERALLOY |
| EFFORT NO | 1 7286 | | | EFFORT NO | 714674 | | | EFFORT NO | 81H158 | | | EFFORT NO | 91 M 1 2 4 | | |
| | * | : | | ; | « | : | : : | : | | : | : | • | k | • | |

| * | EFFORT NO | SERVICE | YEARS OF Funding | STATUS | TITLE | | |
|---|-----------|-----------|---------------------|-------------|--------|---|---|
| | 111184 | AIR FORCE | 80 77 78 | 2 | FCB | PRODUCTION OF LARGE | PRODUCTION OF LARGE NEAR-NET TITANIUM PR PARTS BY HIP |
| | | MATERIAL | APF | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | TITANIUM | A 1 | AIRCRAFT | | AIRFRAME STRUCTURES TURBINE ENGINES | HOT ISOSTATIC PRESSING |
| | EFFURT NO | SERVICE | YEARG DE FUNDILG | STATUS | TITLE | | |
| | 71 H 189 | AIR FORCE | 7.46 0.00 | 2 | F F CR | ADVANCED TL | PUNDER PRODUCTION |
| | | MATERIAL | Id V | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | TITANIUM | AIG | AIRCRAFT | | TURBINE ENGINES | POEDER MAKING |
| | 1 | | | | | AIRFRAME STRUCTURES | r N |
| | EFFORT NO | SERVICE | YEARS UF FUNDING | STATUS | TITLE | | |
| | 11H190 | AIR FORCE | 176 | | MT FOR | VACUUM HOT PRESSING (| MT FOR VACUUM HOT PRESSING OF LARGE TITANIUM SHAPES |
| | | MATERIAL | AP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | MINAFIF | | AIRCRAFT | , | AIRFRAME STRUCTURES | PRESSING, VACUUM HOT |
| | EFFURT NO | SERVICE | YEAR | STATUS | TITLE | | |
| | 118191 | AIR FORCE | 77 78 79 | | #1 FCR | MT FUR ALTERNATE LARGE TITANIUM PM PARTS BY | THE PART OF THE |
| • | | MATERIAL | APF | APPLICATION | | CCHPONENT | SPECIFIC PROCESS |
| | | TITANIUM | AI A | AIRCRAFT | | TITANIUM AIRCRAFT ENGINE COMPONENTS AIRFRAME COMPONENTS | Q. I |

| EFFORT NO | O SERVICE ARMY | YEARS OF STATUS TITLE 79 TITLE 111ANI | TITLE TITANJUM PUMDER METAL COMPRESSOR IMPELLER | T R R |
|-----------|-------------------|---------------------------------------|--|------------------------|
| | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | TITANIUM | AIRCRAFT | SACIONAL PACIONAL PAC | HOT ISOSTATIC PRESSING |

FUTURE SUBCOMMITTEE ACTIONS

INVESTIGATE POSSIBILITY OF A JOINT NAVY/AIR FORCE PROGRAM FOR PM ALUMINUM MILL PRODUCTS INVESTIGATE POSSIBILITY OF A JOINT ARMY/AIR FORCE PROGRAM FOR PM BEARINGS

THE AIR FORCE'S PROGRAM FOR ALUMINUM MILL PRODUCTS AND THE ARMY EXPRESSED DURING THE REVIEWS THE NAVY EXPRESSED INTEREST IN POSSIBLY JOINING INTEREST IN POSSIBLY JOINING THE AIR FORCE'S PROGRAM FOR P/M BEARINGS.

EXTRUSION AND ROLLING

FIVE YEAR FUNDING FORECAST

● 7-10 MILLION

COMPARISON OF FIVE YEAR PLANS

79-83 78-82

FISCAL YEARS

80-84

81-85

2%

COMPARISON OF INDIVIDUAL YEAR PROGRAMS

FISCAL YEAR

28

2

~

8

PROJECTS EXPENDITURES OF BETWEEN 7 10 10 MILLION DOLLARS. THE COMPARISON IN THE EXTRUSION AND ROLLING AREA, THE FIVE YEAR FUNDING FORECAST OF THE FIVE YEAR PLANS SHOWS A RELATIVELY LOW LEVEL OF EFFORT AS DOES THE COMPARISON OF INDIVIDUAL YEAR PROGRAMS.

EXTRUSION AND ROLLING

TECHNICAL OBJECTIVES

- IMPROVE MATERIAL UTILIZATION
- INCREASE ADVANCED MATERIAL CAPABILITY
- IMPROVE MATERIAL WORKABILITY
- INCREASE DEGREE OF AUTOMATION
- **CONSERVE ENERGY**

THE TECHNICAL OBJECTIVES BEING SOUGHT IN THE EXTRUSION AND ROLLING AREA ARE TO IMPROVE MATERIAL UTILIZATION, INCREASE ADVANCED MATERIAL CAPABILITY, IMPROVE MATERIAL WORKABILITY, INCREASE THE DEGREE OF AUTOMATION AND CONSERVE ENERGY.

EXTRUSION & ROLLING

FREQUENCY SPECIFIC PROCESS

AUSTROLLING

COLD ROLLING

EDGE ROLLING ROLLING THREADS ROLLING, ISOTHERMAL

THIS CHART SHOWS THE SPECIFIC PROCESSES BEING ESTABLISHED AND THE NUMBER OF PROJECTS USING EACH SPECIFIC PROCESS.

EXTRUSION AND ROLLING

FY81 PROGRAM REVIEW

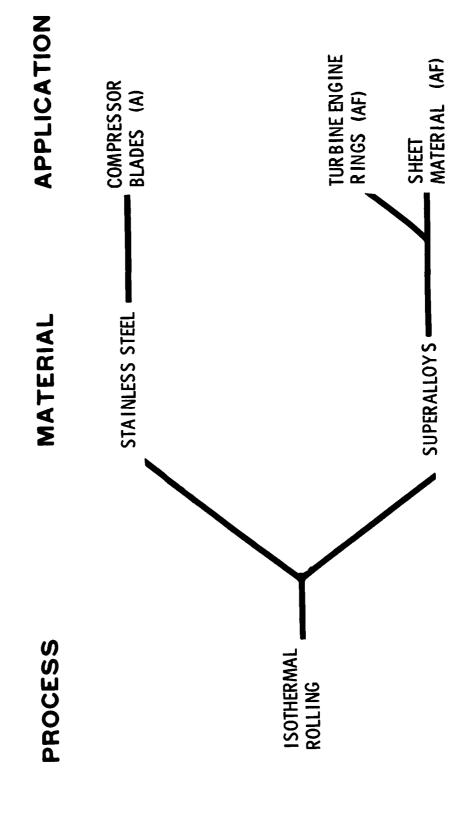
A PROJECTS REVIEWED

D COMMON AREAS IDENTIFIED

● ISOTHERMAL ROLLING

THE SUBCOMMITTEE REVIEWED 4 FY81 PROJECTS DEALING WITH EXTRUSION AND ROLLING. ISOTHERMAL ROLLING WAS IDENTIFIED AS THE ONLY COMMON AREA OF INTEREST AMONG THE SERVICES.

EXTRUSION AND ROLLING



THE ARMY IS ESTABLISHING ISOTHERMAL ROLLING PROCESS FOR MAKING COMPRESSOR BLADES AND THE AIR FORCE IS USING IT TO PRODUCE SUPERALLOY RINGS AND SHEET MATERIAL.

EXTRUSION AND ROLLING

FY80 PROGRAM CHANGES REVIEW

D 2 NEW PROJECTS REVIEWED

COMMON AREAS IDENTIFIED

NO NEW AREAS

TWO NEW FY80 PROJECTS WERE REVIEWED AND NO NEW COMMON AREAS WERE IDENTIFIED THAT HAD NOT BEEN ALREADY IDENTIFIED DURING THE REVIEW OF FY81 PROJECTS,

APPORTIONMENT EXTRUSION AND ROLLING PROJECTS. THE PROJECTS HAVE BEEN THE FOLLOWING COMPUTER PRINTOUT LISTS ALL THE ACTIVE, BUDGET AND SORTED BY THE MATERIAL BEING PROCESSED AND THE APPLICATION.

EXTRUSION

| • | EFFORT NO | 0 | SERVICE | FUNDING STATUS TITLE | STATUS | TITLE | |
|---|-----------|---|-----------|---------------------------------------|-------------|----------------------------|-------------------|
| | 184134 | | AIR FORCE | 91 | | MT FOR TUBULAR PROJECTILES | |
| * | | | MATERIAL | AP | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | | OTHER | A A A A A A A A A A A A A A A A A A A | AMMUNITION | EXTR | EXTRUSION, IMPACT |

| FFDRT NO SERVICE FUNDING STATUS TITLE STEEL APPLICATION COMPRESSOR BLADES FFEDRY NO SERVICE FUNDING STATUS TITLE STEEL APPLICATION COMPRESSOR BLADES STEEL APPLICATION COMPRESSOR BLADES STEEL APPLICATION COMPRISSION GEARS STEEL APPLICATION COMPONENT SPECIFICATION OF WATERIAL APPLICATION OF STATUS TITLE STEEL APPLICATION COMPONENT SPECIFICATION OF SPECIFICATION OF STATUS TITLE STEEL AMOUNTS STATUS TITLE STEEL AMOUNTS STATUS TITLE STEEL AMOUNTS STATUS TITLE STEEL AMOUNTS STATUS TITLE T 5081 ARMY 80 AMUNTS STATUS TITLE T 5081 ARMY 80 FABRICATION OF FRICTION RIMES AND REACTION BOOT, APDS PROJECTILES ROLLIST T 5081 ARMY 80 FABRICATION OF FRICTION RIMES AND REACTION PLATES RECTION PLATES RECTION PLATES REACTION PLATES RECTION PLATES | | EFFURT NO | SERVICE | YEARS OF FUNDING STATUS | | 7171.6 | |
|--|---|--------------------------------------|---------------------------------------|---|-------|---------------------------------|--|
| STEEL AIRCRAFT TURGINE ENGINES STEEL AIRCRAFT TURGINE ENGINES 1 7155 ARMY 78 COST EFFECTIVE WFG METHODS FOR MELICOPTE 1 7155 ARMY 78 CONDUMENT SPECIF MATERIAL APPLICATION COMPONENT SPECIF S 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION S 5 4309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION RINGS AND REACTION RINGS AND | | 1 7036 | 4 E > | 444 | 8 | OTHERMAL ROLL FORGING OF COMPRE | SSOR BLADES |
| EFFORT NO SERVICE FUNDING STATUS TITLE 1 7155 ARMY 78 COST EFFECTIVE MFG METHODS FOR MELICOPTE 2 ASD9-08 ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION OF S 4309-08 ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION OF WATERIAL AMMUNITION BODY, APDS PROJECTILES ROLLIT STEEL AMMUNITION BODY, APDS PROJECTILES ROLLIT STEEL AMMUNITION BODY, APDS PROJECTILES ROLLIT STEEL AMMUNITION STATUS TITLE T 5081 ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION OF T 5081 ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION OF FABRICATION PROJECTILES T 5081 ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION OF FABRICATION PLATES T 5081 ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION FRICTION RINGS AND REACTION FINES T 5081 ARMY 80 RADICATION COMPONENT SPECIFICATION PLATES | | | MATERIAL | APPLICATI | Ň | COMPONENT | SPECIFIC PROCESS |
| EFFORT NO SERVICE FUNDING STATUS TITLE 1 7155 ARMY 78 80 81 MATERIAL APPLICATION COMPUNENT SPECIF STEEL AIRCRAFT TRANSMISSION GEARS GOLD F WATERIAL APPLICATION COMPONENT SPECIF STEEL AMMUNITION BODY, APDS PROJECTILES ROLLLY EFFORT NO SERVICE FUNDING STATUS TITLE T 5081 ARMY 79 MATERIAL APPLICATION COMPONENT SPECIF T 5081 ARMY 79 REACTION RINGS AND REACTION RIN | | | STEEL | AIRCRAFT | 1 | | |
| HATERIAL APPLICATION COMPUNENT SPECIF SERVICE FUNDING STATUS TITLE ARTERIAL APPLICATION COMPONENT SPECIF WATERIAL APPLICATION COMPONENT SPECIF STEEL AMMUNITION BODY, APDS PROJECTILES ROLLIN STEEL AMMUNITION COMPONENT SPECIF ARMY 80 MATERIAL APPLICATION COMPONENT SPECIF STEEL LAND VEHICLES FRICTION RINGS AND REACTION BODY, APDS PROJECTILES FOLLIN STEEL LAND VEHICLES FRICTION PLATES MELDIA REACTION PLATES HELDIA | ì | EFFURT NO | SERVICE | YEARS OF FUNDING STATE | | 11.6 | |
| STEEL AIRCRAFT TRANSMISSION GEARS AUSTRO COLD R LITRAS AND SERVICE FUNDING STATUS TITLE SA309-08 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF WATERIAL APPLICATION DROCESSES FOR ECONOMICAL FABRICATION OF SPECIFIC AMMUNITION BODY, APDS PROJECTILES ROLLIN TSOR! ARMY 80 FABRICATION OF FRICTION RINGS AND REACTION SERVICE FUNDING STATUS TITLE APPLICATION FRICTION RINGS AND REACTION STEEL LAND VEHICLES FRICTION RINGS AND REACTION RINGS AND REACTION RINGS AND PRACESSES FOR ECOMPONENT SPECIFICATION PLATES | | 1 7155 | A X X | 7 8 8 0 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 | 3 | ST EFFECTIVE MFG METHODS FOR ME | ELICOPTER GEARS |
| STEEL AIRCRAFT TRANSMISSION GEARS COLD R COLD R EFFORT NU SERVICE FUNDING STATUS TITLE 5 4309-06 ARMY 80 NU PROCESSES FOR ECONOMICAL FABRICATION OF MATERIAL APPLICATION BODY, APDS PROJECTILES ROLLIN EFFORT NO SERVICE FUNDING STATUS TITLE T 5061 ARMY 79 FABRICATION OF FRICTION RINGS AND REACTION MATERIAL APPLICATION COMPONENT SPECIFICATION PLATES REACTION PLATES REACTION PLATES REACTION PLATES | | | MATERIAL | APPLICAT) | ION | COMPUNENT | SPECIFIC PROCESS |
| FFORT NU SERVICE FUNDING STATUS TITLE SHAND ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION OF STEEL AMMUNITION BODY, APDS PROJECTILES ROLLIN FFORT NO SERVICE FUNDING STATUS TITLE T 5081 ARMY 79 FABRICATION OF FRICTION RINGS AND REACTION MATERIAL APPLICATION COMPONENT SPECIAL RELEGION PLATES | | 9 9 0 0 1 5 0 0 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | TRANSMISSION SEARS | AUSTROLLING COLD ROLLING ULTRASONIC INSPECTION |
| S 4309-08 ARMY 80 NU PRUCESSES FOR ECONOMICAL FABRICATION OF MATERIAL APPLICATION COMPONENT STEEL AMMUNITION BODY, APDS PROJECTILES ROLLIN FEFORT NU SERVICE FUNDING STATUS TITLE T 5081 ARMY 79 FABRICATION OF FRICTION RINGS AND REACTION STEEL LAND VEHICLES FRICTION RINGS WELDIN REACTION PLATES | | EFFORT NU | SERVICE | EARS OF UNDING | | 71.6 | |
| STEEL AMMUNITION BODY, APDS PROJECTILES VEARS OF T 5081 ARMY 79 FABRICATION OF FRICTION RINGS AND MATERIAL APPLICATION COMPONENT STEEL LAND VEHICLES FRICTION PLATES | | 5 4309-08 | ARMY | | | IUCESSES FOR ECONOMICAL FABRICA | TION OF BODY FOR APDS AMMUNITION |
| STEEL AMMUNITION BODY, APDS PROJECTILES YEARS OF T 5081 ARMY 79 FABRICATION OF FRICTION RINGS AND MATERIAL APPLICATION COMPONENT STEEL LAND VEHICLES FRICTION PLATES | | | MATERIAL | APPLICAT | NOI | COMPONENT | SPECIFIC PROCESS |
| YEARS OF EFFORT NU SERVICE FUNDING STATUS TITLE T 5081 ARMY 79 FABRICATION OF FRICTION RINGS AND MATERIAL APPLICATION COMPONENT STEEL LAND VEHICLES FRICTION PLATES | | | STEEL | | į | BODY, APDS PROJECTILES | ROLLING THREADS |
| T 5081 ARMY 79 FABRICATION OF FRICTION RINGS AND MATERIAL APPLICATION COMPONENT STEEL LAND VEHICLES FRICTION RINGS | | EFFORT NO | SERVICE | | | .TLE | |
| IAL APPLICATION COMPONENT LAND VEHICLES FRICTION RINGS REACTION PLATES | | T 5081 | ₹ | 7.00 | ŭ. | IBRICATION OF FRICTION RINGS AN | D REACTION PLATES |
| LAND VEHICLES FRICTION RINGS REACTION PLATES | | | MATERIAL | APPLICAT | 10v | COMPONENT | SPECIFIC PROCESS |
| REACTION PLATES | | | STEEL | LAND VEH | ICLES | | EDGE POLLING |
|) | | | | | | REACTION | |

| # # | 4 60 50 50 50 50 50 50 50 50 50 50 50 50 50 | Ş | u 4 2 0 | YEARS OF | 4 4 | • | | | | | |
|-------|---|----------|------------------|---------------------|-------------|--------|--|------------|----------|------------------|---------------------|
| • | DK TROATS | ? | SEMVICE | | 801416 | 3111 | | | | | |
| * * * | 91H12B | | AIR FORCE | 9 4 9 0 1 | | FOR | ROLLING HIGH TEMPERATURE | TEMPERATUR | ZE SHEET | ⊢ | |
| | | | MATERIAL | ₫. | APPLICATION | | COMPONENT | | | SPECIFIC PROCESS | PROCESS |
| | | | SUPERALLOY | A I A | AIRCRAFT | ; ; | PERALLOY AIRCRAFT TURBINE ENGINES COMBUSTORS | 5 | | SOLLING I | ROLLING ISOTHERMAL |
| | EFFORT NO | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | | |
| | 714868 | | AIR FORCE | 90 | 2 | HT FOR | HT FOR SUPERALLOY ENGINE RING ROLLING | GINE RING | ROLL | 9 2 | |
| | | | MATERIAL | Ā | APPLICATION | | COMPONENT | | | SPECIFIC PROCESS | PROCESS |
| | | | SUPERALLOY | AIA | AIRCRAFT | 6 1 | PERALLOY AIRCRAFT TURBINE ENGINES | . | | | |
| | EFFORT NO | Ĵ | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | | |
| | 51M894 | | AIR FORCE | 76 | | MT FOR | MT FOR ISOTHERMAL ROLLED TITANIUM ENGINE RINGS | LLED TITAN | - WOI! | ENGINE RI | 90 2 |
| | | | MATERIAL | dd v | APPLICATION | | COMPONENT | | | SPECIFIC PROCESS | PROCESS |
| | | | TITANIUM | TANIUM AIRCRAFT | AIRCRAFT | | TURBINE ENGINES | 5 | - | POLLING, | ROLLING, ISOTHERMAL |

COMPARISON OF THE INDIVIDUAL YEAR PROGRAMS. IT APPEARS THAT THE METAL REMOVAL EFFORT SHOULD BEGIN TO LEVEL OFF IN THE NEAR FUTURE. IN THE METAL REMOVAL AREA, THE FIVE YEAR FUNDING FORECAST PROJECTS FIVE YEAR PLANS SHOWS A STRONG UPWARD TREND WHICH IS SUPPORTED BY THE EXPENDITURES OF BETWEEN 48 TO 52 MILLION DOLLARS. THE COMPARISON OF

TECHNICAL OBJECTIVES

- IMPROVE MACHINABILITY DATA BASE
- INCREASE RATE OF REMOVAL
- IMPROVE PROCESS EFFICIENCY
- IMPROVE SURFACE INTEGRITY

IMPROVE PROCESS EFFICIENCY AND IMPROVE (OR AT LEAST NOT DEGRADE) SURFACE IMPROVE THE MACHINABILITY DATA BASE, INCREASE THE RATE OF METAL REMOVAL, THE TECHNICAL OBJECTIVES BEING SOUGHT IN METAL REMOVAL AREA ARE TO INTEGRITY.

| FREQUENCY | FREQUENCY SPECIFIC PROCESS | • | |
|-----------|--------------------------------|-------------|-----------------------------------|
| | | 7 | GKINDING |
| - | ABRASIVE BERT MACHING | က | IN PROCESS INSPECTION AND CONTROL |
| | ABRASIVE PARTICLE FLOW | _ | LAYOUT |
| _ | ADAPTIVE CONTROL | _ | MACHINE TOOL TESTING |
| _ | AUTOMATED HOLE CUTTING | 7 | MACHINING, HIGH SPEED |
| - | BENCHING | 2 | MACHINING, LASER ASSIST* |
| 4 | BORING | | MACHINING, PLASMA ASSIST |
| M | BROACHING | ~ | MACHINING, PRECISION |
| - | CENTRAL COLLANT SYSTEM | · ca | MILLING |
| - | CRUSH FORM GRINDING | _ | MILLING, HIGH SPEED |
| _ | CUTTING FLUID PERORMAN* | _ | MILL 4 SPINDLE, 5 AXIS |
| က | DATA GENERATION | _ | PLASMA ARC CUTTING |
| 4 | DRILLING | | PRECISION PINION MFR |
| _ | DUAL RIFLING | _ | ROTATING CUTTER CUT OFF |
| 4 | ECM | _ | ROUGH THREAD BLANKING |
| _ | ECONOMIC MODELING | _ | SLITTING |
| 7 | EDM | | STANDARDS FOR SURF FIN |
| 7 | ELECTROPOLISHING | 7 | TOOL DESIGN |
| _ | ENGRAVING, PORTABLE | _ | TOOLS, COATING |
| 7 | FIXTURING | 9 | TURNING |
| _ | FLEXIBLE MACHINING | _ | TURN, MILL, DRILL |

THE SPECIFIC PROCESSES AND THE NUMBER OF PROJECTS INVOLVED WITH EACH PROCESS IS SHOWN ON THIS CHART.

FY 81 PROGRAM REVIEW

- 27 PROJECTS REVIEWED
- COMMON AREAS IDENTIFIED
- MACHINING HOLLING
- IN PROCESS INSPECTION AND CONTROL
- MIGH SPEED MACHINING
- P ECM/EDM
- PRESCISION MACHINING

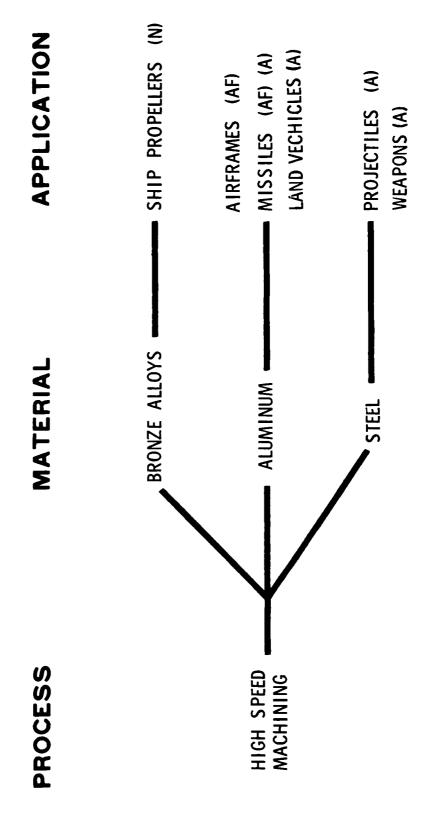
THE SUBCOMMITTEE REVIEWED 27 FY81 PROJECTS; HOT MACHINING, IN PROCESS INSPECTION AND CONTROL, HIGH SPEED MACHINING, PRECISION MACHINING, AND ECM/EDM WERE IDENTIFIED AS COMMON AREAS.

APPLICATION TUR BINE ENGINES (AF) (A) PROJECTILES (A) MATERIAL SUPERALLOYS STEEL . HOT MACHINING **PROCESS**

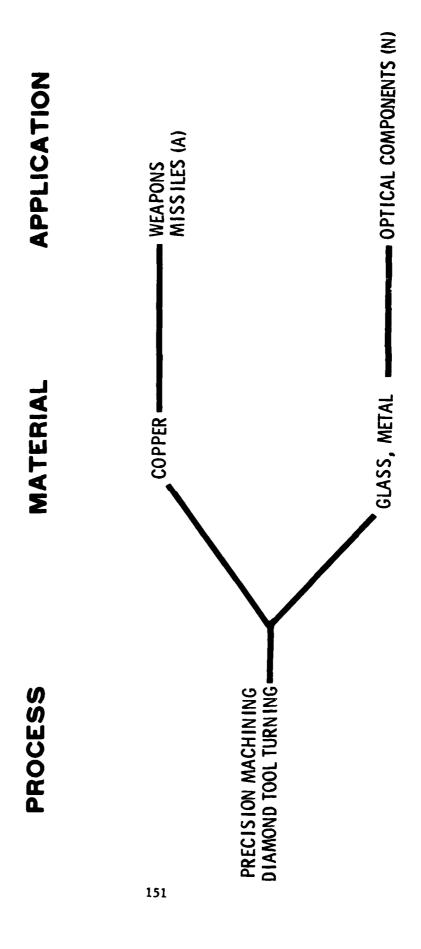
MACHINING FOR SUPERALLY TURBINE ENGINE COMPONENTS. THESE SERVICES WILL BOIH THE ARMY AND AIR FORCE ARE PROPOSING TO USE LASER ASSISTED MEET TO DISCUSS HOW DUPLICATION WILL BE AVOIDED.

APPLICATION RECOIL MECHANISMS (A) _TURBINE ENGINES (AF) TUR BINE ENGINES (A) SUPERALLOYS. MATERIAL - TITANIUM . STEEL **PROCESS** IN PROCESS INSPECTION & CONTROL

THE ARMY AND AIR FORCE WILL MEET TO DISCUSS HOW DUPLICATION CAN BE AVOIDED IN THE APPLICATION OF IN PROCESS INSPECTION AND CONTROL.



THE ARMY AND AIR FORCE WILL MEET TO DISCUSS HOW THE HIGH SPEED MACHINING OF ALUMINUM EFFORTS, THE DARPA FUNDED RESEARCH EFFORT AND THE STLEL HIGH SPEED MACHINING EFFORTS CAN BE INTEGRATED INTO A COHESIVE PROGRAM WHICH ELIMINATES DUPLICATION OF EFFORT.



APPLICATION TURBINE ENGINES (N) (AF) HELICOPTER MISSILES (A) ■ SUPERALLOYS MATERIAL , STEEL ECM / EDM • **PROCESS**

THE NAVY AND AIR FORCE ARE APPLYING ECM TO TWO DIFFERENT TYPE MACHINING PROBLEMS. THE SUBCOMMITIEE DETERMINED THAT NO DUPLICATION EXISTED.

FY 80 PROGRAM CHANGES REVIEW

D 1 NEW PROJECTS REVIEWED

COMMON AREAS IDENTIFIED

NO NEW AREAS

THE SUBCOMMITTEE REVIEWED 1 NEW FY80 PROJECT. NO NEW COMMON AREAS WERE IDENTIFIED THAT HAD NOT BEEN IDENTIFIED DURING THE REVIEW OF THE FY81 PROJECTS.

BUDGET PROJECTS WHICH HAVE BEEN CLASSIFIED AS METAL REMOVAL. THE PROJECTS THE FOLLOWING COMPUTER PRINTOUT LISTS THE ACTIVE, APPORTIONMENT, AND HAVE BEEN SORTED BY THE MATERIAL BEING MACHINED AND ITS APPLICATION,

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|-------|-----------|----------------------|---|---------------|---------|--|--|
| | 014259 | AIR FORCE | ପ୍ରକ୍ର ପ୍ରକ୍ର | o z | FOR | ADVANCED METAL REMOVAL INITIATIVE | WAL INITIATIVE |
| | | MATERIAL | ₫ ◀ | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | ALUMINUM | 14 | AIRCRAFT | | TURBINE ENGINES | ECONOMIC MODELING TOCLS, INNOVATIVE MACHINING, LABER ASSISTE |
| | | | H 1 | TISSILES | | 0 170 CT C R B B B B B B B B B B B B B B B B B B | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 1 5093 | A E F | 40 40 40 40 | | #16H=06 | PEED MACHINING OF TC | HIGH-SPEED MACHINING OF TCV COMPONENTS (PHASE 1) |
| | | MATERIAL | 4 | APPLICATIUN | | COMPONENT | SPECIFIC PROCESS |
| | | MUNIMULA FUNIMULA | L A | LAND VEHICLES | 8 | XXZ VEHICLE | MACHINING, HIGH SPEED |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 02M271 | AIR FURCE | 6 0 €0 | 2 | MT FOR | HIGH SPEED MACHINING | و |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | ALINTMINA | N 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | MISSILES | | STRUCTURES 111111111111111111111111111111111111 | |
| | FFORT NO | | YEARS OF Funding | STATUS | TITLE | | |
| | 01500820 | > > 4 2 | 7.8 | | HIGH SE | SPEED MACHINING OF SH | SHIP PHOPELLERS |
| | | MATERIAL | 4 | APPLICATION | | CUMPONENT | SPECIFIC PHOLESS |
| | | BRONZE | S | SHIPS | | PROPELLER | MILLING, MIGH SPEED |
| 1 2 1 | | | | | | | |

| | FOR DIAMOND TURNED OPTICAL PARTS | SPECIFIC PROCESS | OPTICAL MIRRORS MACHINING, PRECISION OPTICAL MIRRORS FOR SURF FIR | | NED OPTICS | NT SPECIFIC PROCESS | MACHINING, PRECISION | | PRECISION MACHINING OF OPTICAL COMPONENTS | SPECIFIC PROCESS | MACHINING, PRECISION | | MACHINE TOOL TASK FORCE | NT SPECIFIC PROCESS | ಲ 1 |
|-------------------|----------------------------------|------------------|---|-----------------|-------------------|---------------------|---|-----------------|--|------------------|---|----------------------------|-------------------------|---------------------|------------------------|
| TITLE | STANDARDS FOR | COMPONENT | OPTICAL | | LOW COST MACHINED | COMPONENT | D C E S E S E S E S E S E S E S E S E S E | 71715 | PRECISION MACH | COMPONENT | SECRET | TITLE | MT FOR MACHINE | COMPONENT | STRUCTURES MISSILES |
| YEARS OF STATUS | 81 82 | APPLICATION | ø 20 | YEARS OF STATUS | D. ₩ | APPLICATION | R ALLOY MISSILES | YEARS OF STATUS | 30 74 81 | APPLICATION | 0 1 1 1 0 0 1 E 1 1 1 1 1 1 1 1 1 1 1 1 | YEARS UF FUNDING STATUS | 90 og | APPLICATION | AIRCRAFT |
| YE. SERVICE FU | ₹ | MATERIAL | COPPER | SERVICE FU | > A < | MATERIAL | COPPER ALLOY | SERVICE FU | ≻ 30 4 | MATERIAL | COPPER ALLOY | YE. | AIR FORCE | WATERIAL. | 71 E R |
| EFFORT NO | * 6 8165 | į | | | * 04800693 | | | EFFORT NO | 10 13 13 14 14 14 14 14 14 14 14 14 14 14 14 14 | ; | | EFFURT NO | * 81H261 | | |

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| • | | | la. | | | | |
|--------|-----------------|--------------------|-------------------------|---------------------------------|---|------------------------------------|---------|
| : | EFFORT NO | SERVICE | FUNDING STATUS | TITLE | | | |
| | 81 1 7 6 0 | AIR FORCE | 7.8 | MT FUR | VERIFICATION OF | PRODUCTION HOLE GUALITY | |
| | | MATERIAL | APPLICATION | z | COMPONENT | SPECIFIC PROCESS | |
| | 1 1 1 | | AIRCRAFT | 4 9 9 1 1 1 1 | AIRFRAME Mole Quality | DRILLING | |
| | EFFURT 40 | SERVICE | 2 | TITLE | | | |
| * | 5~A00277 | × > 4 \ | 7.9 | CUTTIN | CUTTING TOOL COATING | | |
| | | MATERIAL | APPLICATION | z | CGMPONENT | SPECIFIC PROCESS | |
| | E | STEEL | AIRCRAFT | | 4 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | TOOLS, CUATING | |
| | E F F L | SERVICE | YEARS OF FULDING STATUS | | | | |
| * | 1 7104 | ≻ 1 α | 7.8 7.7 | TURBINE | E NOZZLE MANUFACTURING TECHNOLOGY | 7EC#NOLD6Y | |
| | | MATERIAL | APPLICATION | z | COMPONENT | SPECIFIC PROCESS | |
| | | | AIRCRAFT | | TUPBINE ENGINES TISC COMPONENTS | GRINDING | |
| | عد ند ندا | SER/ICE | | TITLE | | | |
| | 1 7240 | >- 2: 4 | 7 4 8 9 4 9 9 6 | 9 1 1 1 1 1 1 | METHODS FOR ESA | 4340 STEEL MELICOPIER APPLICATIONS | es C |
| | | MATERIAL | APPLICATION | z | COMPONENT | SPECIFIC PROCESS | |
| R R | | 97FEL | AIRCRAFT | | INTEGRAL ARMOR COMPUNENT | ENT ECH EDH | |
| | | | | | | | |

| | EFFURT NO | SERVICE | YEARS OF FUNDING STATUS | TITLE | |
|---|---------------------------------|------------------|--|--|--|
| : | 5 4402 | > 1 0 4 | 981 32 | IMPROVED HSS PRECISION GEAR HOBS | AR HOBS |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | NON THE PERSON THE PER | FUZE | PRECISION PINION MFR |
| | EFFORT NO | U | YEARS OF FUNDING STATUS | TITLE | |
| | 5 6738 | ₩ | 79 | ULTRA HIGH SPEED METAL RE | HIGH SPEED METAL REMUVAL, ARTILLERY SMELL |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| * | | STEEL | AMMENITION | PROJECTILE, ARTILLERY | TURNING |
| | 0 0 0 0 0 0 | | 4 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 | PROJECTILE, MORTAR | - Property Control of the property of the prop |
| | EFFURT NO | SERVICE | YEARS OF STATUS | | |
| • | T 5082 | > 2 4 | 7.00 0.00 0.01 | FLEXIBLE MACHINING SYSTER | FLEXIBLE MACHINING SYSTEMS PILOT LINE FOR TCV COMPONENTS |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | LAND VEHICLES | S MID VOLUME COMPONENTS | NTS FLEXIBLE MACHINING |
| | EPFURT NU | SERVICE | YEARS OF FUNDING STATUS | TITLE | |
| • | 1 5090 | > | 4 00 4 1 1 | IMPROVED AND COST EFFECTIVE MACHINING TECHNOLOGY | VE MACHINING TECHNOLOGY |
| | | VATEPIAL | APP_ICATION | COMPONENT | SPECIFIC PROCESS |
| | | STFEL | LAND VEHICLES | S HOUSINGS | TURN, HILL, DRILL |
| ! | 0 0 0 0 0 0 0 | | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | COVERS | NOT-WENDS WIND |

METAL REMOVAL

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
|---------------|--|----------------|--|---------------|---|---|
| * * | R 1018 | ARMY | 80 | | IMPROVED MANUFACTURING PROCESSES FOR DRY TUNED ACCELEROMETERS | S FOR DRY TUNED ACCELEROMETERS |
| | | MATERIAL | 1 4 V | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| * * * | STEEL | STEEL | ¥ | T SO I LEG | MISSILES ACCELEROMETER, DRY TUNED | ECM |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | <u>ji</u> 13 9- 14 14 1- 14 | |
| * * | DNS00638 | > | 0 | | AUTOMATIC PLASMA ARC CUTTING MACHINE | E PER CENTRAL PROPERTY OF THE |
| | | MATERIAL | 84 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | O TEEL | 1 0 5 1 1 | 84118 | PIPE BOX TUBING I BEANS | PLASMA ARC CUTTING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | 11116 | |
| * * | CNS00635 | * > 4 2 | 0 | | HULL ACCESS HOLES AUTOMATIC CUTTING | - I N C |
| | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| ÷ . ! | | STEEL | 上の # # # # # # # # # # # # # # # # # # # | SHIPS | SHIPS | AUTOMATED HOLE CUTTING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| * * * * | 6 8342 | A 2 X X | 0.6 | | KEYWAY MILLING MACHINE | |
| | | MATERIAL | AP | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | 11日下の 11日下 11日下 | STEEL | | * E A P C N S | MEAPONS BARREL, CANNON | MILLING |

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | 71116 | |
|----------------------|------------|----------|--|---------------|---|-----------------------------|
| 44 41 44 48 48 | 6 7730 | ARMY | 79 | | MANUFACTURE OF SPLIT RING BREECH | SEALS |
| | | MATERIAL | ₽q▲ | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| * | | STEEL | W X | A F A P C N S | BREECH RING SEALS | SLITTING |
| | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | 1.6 | |
| | 6 8107 | ≻ | 9 9 1 1 | | CREEP FEED CRUSH FURM GRINDING | |
| ; | | MATERIAL | APP | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | N T | EEAPON0 | BRACKET FOR BREECH BLOCK RACK TEETH FOR COUPLING | CRUSH FORM GRINDING |
| | EFF ORT NO | SERVICE | 0 8 G | - | u u | |
| * | \$ 805¢ | 4 E | O (V) | | HIGH SPEED ABRASIVE BELT GRINDING | |
| ; | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | AE/ | HE A PONO | BARREL, CANNON | ABRASIVE BELT MACHING |
| , | EFFORT NO | SERVICE | YEARS OF FUNDING | SIATUS | TITLE | |
| | 6 6105 | A A A | 36 1.0 | | ESTABLISH ROUGH THREAD BLANKS, 8. | BLANKS, B-INCH M201 BUSHING |
| | | MATERIAL | ĕ d ▼ | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | 13 x 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | * E APONG | BARREL, CANNON | ROUGH THREAD BLANKING |
| |) |) | | | | |

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| | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|--------------|-----------------------|-------------------|-----------------------|-----------------|--------------------------------------|---------------------------|-----|
| * | 6 B120 | ARM Y | 81 | | ADAPTIVE CONTROL TECHNOLOGY | > | |
| ; | | MATERIAL | A P | APPLICATIUN | COMPONENT | SPECIFIC PROCESS | |
| | | STEEL | A | WEAPONS | CANNON COMPONENTS | ADAPTIVE CONTROL DRILLING | |
| | EFFORT NO | SERVICE | YEARS UF FUNDING | STATUS | TITLE | | |
| * * * * * | 9106 | A X X | 60 60 60 C) 11 (V) | | LARGE CALIBER POMDER CHAMBER BURING | SER BURING | |
| | | MATERIAL | 6 ∀ | APPLICATION | COMPONENT | SPECIFIC PROCESS | |
| | 0 0 0 0 0 | STEEL | - W | AEAPONG 1111 | BARRELS, CANON | BORING, BALANCED TOOL | 100 |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| * * * * | 6 7927 | 4 5 5 | æ æ | | GENEHATION OF BASE MACHINING SURFACE | ING BURFACE | |
| | | MATERIAL | A P P | APPLICATION | COMPONENT | SPECIFIC PROCESS | |
| | | STEEL | 1 | *EAPOZO | *EAPONS BREECH COMPONENTS | LAYOUT | |
| | EFFORT NO | ั้ง | YEARS OF FUNDING | STATUS | TITLE | | |
| | 6 7925 | > ± α < | 9 1 8 | | BOPE EVACUATOR BORING | | |
| ; | | MATERIAL | App | APPLICATION | COMPONENT | SPECIFIC PROCESS | |
| | | STEEL | E E | WEAPONS | CANNON TUBES BORE EVACUATOR | BORING | |
| | | | | | | | |

| * | | | | | | | |
|-----|-----------|---|---|---------------------|-------------|-----------------------------------|---------------------------------------|
| | EFFORT NO | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| : . | 6 7933 | | ARMY | 7.0 | | CENTRAL COLLANT SYSTEMS | |
| | | | MATERIAL | 404 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | • | | | OZOGVUR OZOGVUR | PEADOZO | CANNON TUBES | CENTRAL COLLANT SYSTEM CUTTING FLUIDS |
| : | EFFORT NO | 2 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| *** | 0 7948 | | ₹ Σ Σ | 80 79 81 | | ESTABLISH CUTTING FLUID CONTROL | OL SYSTEM |
| * | | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | ; | OTEEL 1 | Q A | HEAPUNG | GUN MUUNTS | CUTTING FLUID PERFORMAND |
| | EFFORT NO | 0 | SERVICE | YEARS OF FUNDING | STATUS | 1174 | |
| | 6 8043 | | ARMY | 7.6 | | IMPROVED MACHINING PROCEDURES FOR | FOR DOVETAILS |
| • | | | MATERIAL | d d ▼ | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | | STEEL | : | MEAPONS | MEAPONS CANNON BARRELS | BROACHING |
| | EFFORT NO | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| | 6 6047 | | A 2 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | 780 | | PAGG THRU STEADY RESTS FOR TU | FOR TUBE TURNING |
| : | | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| * * | 1 | | | E A | HEAPONS | FEADONS CANNON TUBES | TURNING FIXTURING |
| | | , | | | | | |

METAL REMOVAL

| | SPECIFIC PROCESS Rotating Cutter cut off | | SPECIFIC PROCESS Turning | | FOR POADER CHAMBERS SPECIFIC PROCESS GRINDING IN PROCESS INSPECTION | SPECIFICATIONS | SPECIFIC PROCESS Machine tool testing |
|--|---|----------------------------------|-----------------------------|----------------------------------|---|--|--|
| TITLE Mollow Cylinder cut off machine | APPLICATION COMPONENT WEADONS CANNON TUBES | TITLE HIGH VELUCITY MACHINING | COMPONENT CANNON TUBE | 7111.6 | ADOUT GAGE | TITLE ESTABLISH MACHINE TOOL PERFORMANCE SPECIFICATIONS | APPLICATION COMPONENT MEAPONS GENERAL |
| YEARS UF FUNDING STATUS 80 81 | APPLICATION Weadons | YEARS OF FUNDING STATUS 82 81 84 | APPL (CATION HEAPONS | YEARS OF FUNDING STATUS | APPLICATION Weadons | LF NG STATUS | APPLICATION HEAPONS |
| EFFORT NO SERVICE 6 8341 ARMY | MATERIAL | EFFORT ND SERVICE 6 8103 ARHY | MATERIAL STEEL | EFFORT NO SERVICE 6 8025 ARMY | | EFFORT NU SERVICE 6 7802 ARMY | MATERIAL STEEL |
| * * * * | | # # # # # # # frj =0 | | * * | •••• | 16. 4. 4. 4. 4. | * |

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| | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
|-----------------|----------------------------|---------------------------------------|--------------------------------------|---------------------------------------|---|---------------------------------|
| # # # • | 6 7715 | ARMY | 7.7 | | APPLICATION OF CONTROLLED-FORCE MACHINING | E MACHINING |
| | | HATERIAL | ď | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | ; 0 0 0 0 1 | STEEL | W 1 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | WEAPONS GENERAL | BORING MILLING DRILLING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| * * * * | 6 7707 | A & M Y | 11 | | AUTOMATED PROCESS CONTROL FOR MACHINING-CAM | HACHINING-CAM |
| ; | | MATERIAL | Ĭď. | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| ! | 0 0 0 0 0 | STEEL | 1 1 1 1 1 1 1 1 | YE APONG | GENERAL | MACHINEABILITY DATA COMPUTERIZE |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| # # # # | 6 7652 | * | 11 | | APPLICATION OF CUDLANT CHIP EJECTOR TODLING | ECTOR TOOLING |
| : | | MATERIAL | ď | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| # # # # • | | STEEL | 3 | WEAPONS | LARGE CALIBER | DRILLING |
| ! | | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | | 9 9 9 | RECUIL MECHANISMS | 917176 |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | SIATUS | TITLE | |
| k k | 9 7485 | ARMY | 11 | | APPLICATION OF CHEMICAL PROCESSES TO IMPROVE SURFACE FINISH | SES TO IMPROVE SURFACE FINISH |
| ; | | MATERIAL | Ida | APPLICATION | COMPONENT | SPECIFIC PHOCESS |
| k k | | STEEL | 3 | WEAPONS | LARGE CALIBER | ELECTRUPULISHING |

| | EFFORT NO | Q | SERVICE | YEARS OF FUNDING | STATUS | 7 7 7 6 | | |
|-----|-----------------------|---|-----------|---|--------------|---------------------------------------|---|---|
| : . | 6 7482 | | ₹ | 4 | | MODIFI | MODIFIED RIBBON RIFLING GENERATING MACHINE | IN TACULINA |
| | | | MATERIAL | 404 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| • | | | STEEL | EFA | FEAPONG | ; ; ; ; | LARGE CALIBER TUBES | DUAL RIFLING |
| | EFFORT NO | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| ı | 6 7317 | | P D A | 79 | | OPTIMI: | OPTIMIZATION OF STEP THREAD TOOLING | LING |
| * | | | MATERIAL | d d v | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | 1 9 9 1 8 | , | STEEL | 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | KEAPONG | , , , , , , , , , , , , , , , , , , , | LARGE CALIBER BREECH MECHANISMS | TOUL DESIGN |
| | EFFORT NO | Ş | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 6 7246 | | A X | 61 | | SIMPLIF | SIMPLIFICATION OF BREECH RING M | BREECH RING MANUFACTURING AND HANDLING |
| _ | | | MATERIAL | 464 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | STEEL | | 9 1 E E L | Ø Z D d ₹ U 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | EE P D O N O | | LARGE CALIBER BREECH MECHANISHS 105MM W&& BREECH RING | T X T C N I N I N I N I N I N I N I N I N I N |
| | EFFURT 40 | | SERVICE | YEARS OF FUNDING | STATUS | 7176 | | |
| | 6 7825 | | ARMY | 78 | | ELIMINA | ELIMINATION OF FACILITATING HONING OPERATIONS | ING OPERATIONS |
| * | | | MATERIAL | lddv | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | STEEL | IEA. | HEAPONG | | LARGE CALIBER | BORING |
| i | | i | | | | | TUBES | TOOL GEOMETRY |

METAL REMOVAL

| | FOR ARMAMENT COMPONENTS | SPECIFIC PROCESS | ELECTROPOLISHING | | RIFLING MFG TECHNIQUES | SPECIFIC PROCESS | BROACHING, ULTRASONIC | | WEAPON COMPONENTS | SPECIFIC PROCESS | MACHINING, HIGH SPEED | | u z | SPECIFIC PROCESS | IN PROCESS INSPECTION TURNING MAIL TAGE |
|-----------------|-------------------------------|------------------|--|-----------|-------------------------------|------------------|---------------------------------------|--------------------------|-------------------------------|------------------|---------------------------------------|-------------------------|---|------------------|---|
| TITLE | ELECTROPOLISHING PROCESSES FO | CUMPONENT | SMALL CALIBER BARRELS | TITLE | IMPROVED SC GUN BARREL RIFLIN | COMPONENT | BARREL, GUN, GC | TITLE | HIGH SPEED MACHINING OF SC ME | COMPONENT | SMALL CALIBER: MPTS | TITLE | IN-PROCESS CONTROL OF MACHINING | COMPONENT | RECUIL CYCLINDERS |
| TEARS OF STATUS | 7.7 | APPLICATION | 92 Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z | OF STATUS | 81 82 | APPLICATION | FE APONG | YEARS OF FLINDING STATUS | | APPLICATION | SEAPONG | YEARS OF FUNDING STATUS | 8 8 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 | APPLICATION | O Z D D V Z |
| ND SERVICE | A B B A | HATERIAL | STEEL | S | ¥ ₩ | MATERIAL | STEEL | NO SERVICE | ≻ ₩ | HATERIAL | STEEL | NO SERVICE | A 4 A 4 | MATERIAL | STEEL |
| EFFORT NO | 6 7711 | | | EFFORT NO | * 6 8162 | | , , , , , , , , , , , , , , , , , , , | EFFORT NO | 77910 | | , , , , , , , , , , , , , , , , , , , | EFFORT NO | * 6 8135 | | |

| | « • | ON THURST | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
|--|--------|-----------|-------------|------------------|-----------------------|-------------------------------|---------------------|
| STEEL READING CANNON STEEL READING CANNON FFFORT NO SERVICE FUNDING STATUS TITLE BI PORTABLE ENGRAVING SYSTEM BATERIAL APPLICATION COMPONENT STEEL MEADONS CANNON STEEL MEADONS CANNON FFFORT NO SERVICE FUNDING STATUS TITLE CANNON FFFORT NO SERVICE FUNDING STATUS TITLE CANNON THERDON THERDON TEAPONS TOMPONENT TOMPONENT TEAPONS TOMPONENT TOMPONEN | # | 6 7928 | A E > | 80 80 10 10 | 3 | ROBOTIZEO BENCHING OPERATIONS | |
| STEEL HEAPONS CANNON EFFORT NO SERVICE FUNDING STATUS TITLE EFFORT NO SERVICE FUNDING NO NO MANUFACTURE OF CURPORED TO STATUS TITLE EFFORT NO SERVICE FUNDING STATUS TITLE EFFORT NO SERVICE FUNDING NO NO MANUFACTURE OF CURPORED TO STATUS TITLE EFFORT NO SERVICE FUNDING NO NO MANUFACTURE OF CURPORED TO STATUS TITLE EFFORT NO SERVICE FUNDING NO NO MANUFACTURE OF CURPORED TO STATUS TITLE EFFORT NO STATUS TITLE STATUS TITLE EFFORT NO STATUS TITLE STATUS TITLE STATUS TO | • | | MATERIAL | - | LICATION | COMPONENT | SPECIFIC PROCESS |
| BREECH BLUCKS GREECH RINGS FFORT NO SERVICE FUNDING STATUS TITLE HATERIAL APPLICATION COMPONENT STEEL HEADONS CANNON, 105MM STEEL HEADONS TITLE GONONENT HATERIAL APPLICATION COMPONENT STEEL HEADONS CANNON, 105MM STEEL HEADONS CONNON, 105MM STEEL HEADONS TITLE CONPONENT DNAOO752 NAVY BD NU MANUFACTURE OF CURVED CODLING HOLD DNAOO752 NAVY BD NU MANUFACTURE OF CURVED CODLING HOLD BAPLICATION COMPONENT HATERIAL APPLICATION COMPONENT HATERIAL APPLICATI | ** | | | 13 H | SNUA | CANNON | BENCHING Robots |
| FFORT NO SERVICE FUNDING STATUS TITLE 6 8151 ARMY 81 BORTABLE ENGRAVING SYSTEM 8 7 EARS OF EFFORT NO SERVICE FUNDING STATUS TITLE 6 8057 ARMY 80 DUAL RIFLING BROACH REMOVAL SYSTEM 6 8057 ARMY 80 NU MANUFACTURE OF CURVED COOLING HOLD EFFORT NO SERVICE FUNDING STATUS TITLE STEEL MEAPONS COMPONENT MATERIAL APPLICATION COMPONENT MATERIAL APPLICATION COMPONENT MATERIAL APPLICATION COMPONENT | | | | | 8 8 8 8 8 | | |
| FFORT NO SERVICE FUNDING STATUS TITLE EFFORT NO SERVICE FUNDING STATUS TITLE CANNON, 105MM STEEL WEAPONS GOUN, M66 DNA00752 NAVY MATERIAL PORTABLE ENGRAVING SYSTEM CANNON COMPONENT MATERIAL APPLICATION AIRCRAFT TURBINE ENGINES | | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| STEEL WEAPONS CANNON STEEL YEARS OF 6 8057 ARMY 80 DUAL RIFLING BROACH REMOVAL SYSTEM CANNON, 105MM STEEL WEAPONS CANNON, 105MM COMPONENT STEEL WEAPONS CANNON, 105MM GUN, M68 DNA00752 NAVY BO NU MANUFACTURE OF CURVED COOLING MOL DNA00752 NAVY APPLICATION COMPONENT TURBINE ENGINES | * * * | 6 8151 | **** | 89 SP 17 N | | PORTABLE ENGRAVING BYSTEM | |
| FFORT NO SERVICE FUNDING STATUS TITLE EFFORT NO SERVICE FUNDING STATUS TITLE 6 8057 ARMY 80 DUAL RIFLING BROACH REMOVAL SYSTEP 6 8057 ARMY 80 DUAL RIFLING BROACH REMOVAL SYSTEP CANNON, 105M GUN, M68 EFFORT NO SERVICE FUNDING STATUS TITLE EFFORT NO SERVICE FUNDING STATUS TITLE AMTERIAL APPLICATION COMPONENT ASSUPERALLOY AIRCRAFT TURBINE ENGINES | * | | MATERIAL | ď | PLICATION | COMPONENT | SPECIFIC PROCESS |
| FEFORT NO SERVICE FUNDING STATUS TITLE 6 8057 ARMY BO DUAL RIFLING BROACH REMOVAL SYSTEM MATERIAL APPLICATION COMPONENT STEEL MEAPONS GUN, M66 EFFORT NO SERVICE FUNDING STATUS TITLE DNA00752 NAVY BO NU MANUFACTURE OF CURVED COOLING MOLE MATERIAL APPLICATION CUMPONENT TURBINE ENGINES | * . | | STEEL | 3 1 | PD0v0 | CANON | ENGRAVING, PURIABLE |
| 6 8057 ARMY 80 DUAL RIFLING BROACH REMOVAL SYSTEM STEEL APPLICATION COMPONENT STEEL HEAPONS CON, M68 EFFORT NO SERVICE FUNDING STATUS TITLE DNA00752 NAVY 80 NU MANUFACTURE OF CURVED COOLING HOLE SUPERALLOY AIRCRAFT TURBINE ENGINES | | | | YEARS OF FUNDING | STATUS | TITLE | |
| STEEL MEAPONS CANNON, 105MM E PONS CANNON, 105MM E PONS CANNON, 105MM E PONS GUN, M68 EFFORT NO SERVICE FUNDING STATUS TITLE DANO1752 NAVY BO NU MANUFACTURE OF CURVED CODLING HOLE DAPLICATION COMPONENT TURBINE ENGINES | * • | A 8057 | | 0 | | DUAL RIFLING BROACH REMOVAL | S≺STEM STEM |
| STEEL WEAPONS CANNON, 105MM GUN, M68 YEARS OF EFFORT NO SERVICE FUNDING STATUS TITLE DNA00752 NAVY 80 NU MANUFACTURE OF CURVED CODLING MOLE MATERIAL APPLICATION COMPONENT SUPERALLOY AIRCRAFT TURBINE ENGINES | R | | MATERIAL | 4 | PPLICATION | COMPONENT | SPECIFIC PROCESS |
| YEARS OF STATUS TITLE SERVICE FUNDING STATUS TITLE NAVY BO NU MANUFACTURE OF CURVED COOLING MOLE MATERIAL APPLICATION COMPONENT SUPERALLOY AIRCRAFT TURBINE ENGINES | : | | STEEL | Ī | EAPUNS | GUN, MOSAM GUN, MOS | BROACHING |
| NAVY 80 NU MANUFACTURE OF CURVED COOLING MOLE MATERIAL APPLICATION COMPONENT TURBINE ENGINES SUPERALLOY AIRCRAFT | | | | • | 91A1US | TITLE | |
| MATERIAL APPLICATION COMPONENT SUPERALLOY AIRCRAFT TURBINE ENGINES | * | DNA00752 | _ | 90 | 2 | MANUFACTURE OF CURVED COOL! | NG HOLES |
| TURBING ENGINES | • | | MATERIAL | | PPLICATION | COMPONEN | SPECIFIC PROCESS |
| | * * | 4 | SUPERALL | ٠٥, | IRCRAFT | TURBINE ENGINES | £ 10 |

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|-----------------|---------------------------------|-------------|------------------|-------------|---------|---|---|
| * * * * | DNA00700 | **** | 18 | | HIGH | HIGH TEMPERATURE HIGH STRENGTH LAMINATE | TI LABINATE |
| | | MATERIAL | * | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | ; ; ; ; | SUPERALLOY | : | AIRCRAFT | 1 | AIRCRAFT FLUIDIC CONTROLS | MACHINING PLATING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| * | 01 M280 | AIR FORCE | 90 | 3 2 | MT FUR | MT FOR ADVANCED METAL REMOVAL TECHNIQUES | L TECHNIQUES |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| : ! | 0 0 0 0 1 0 0 | SUPERALLOY | ! | AIRCRAFT | | TURBINE ENGINES | TURNING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| * * | 1 7156 | A R. R. A | 16 | | ULTRAS | ULTRASONICALLY ASSISTED MACHINING FOR SUPERALLOYS | INING FOR SUPERALLOYS |
| | | MATERIAL | ¥ | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | SUPERALLOY | . Y | DY AIRCRAFT | 1 | ROTUR SYSTEM ISC COMPONENTS | MACHINING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| * * * * * | 1 /103 | Α Σ Σ | 77 | | 8L 1 SK | AND IMPELLER MFG | BY AUTOMATIC MULT-SPINGLE MACHINING |
| | | MATERIAL | Ť | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| * * * * | | SUPERALLOY | | AIRCRAFT | | COMPRESSOR | MILL, 4 SPINDLE, 5 AXIS ABRASIVE PARTICLE FLUM |
| | | | | | | 30. | |

| | EFFORT NO | ON | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|------------------------|---------------------------------------|-----|------------|--|---------------|-------------|---------------------------------------|--------------------------|
| * * | 1 7366 | | A A A | 69 62 52 | | SPIRAL | SELF-ACTING SEAL | |
| | | | MATERIAL | AP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | # # # # # # # # # # # # # # # # # # # | | SUPERALLOY | | AIRCRAFT | 1 | TURBINE ENGINES SPIRAL GROOVE SEAL | METAL REMOVAL |
| | EFFORT NO | O S | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| t 1 2 4 0 | 818254 | | AIR FORCE | 78 | | MT FOR | AUTOMATED ECM BORE ENTRY | Y DISK FABRICATION |
| | | | MATERIAL | APP | APPL ICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | SUPERALLOY | | AIRCRAFT | | DISKS TURBINE ENGINES | ECM, AUTOMATION |
| | EFFURT NO | Õ | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | T 6008 | | 4 T | # &' 60 | | LASER A | LASER ASSISTED MACHINING | |
| | | | MATERIAL | ₫ ₫ | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| • | | | SUPERALLOY | | LAND VEHICLES | 40 | TURBINE ENGINES | MACHINING, LABER ASSISTE |
| . ! | | | | ************************************** | | | XX | ۵ |
| : | EFFORT NO | ģ | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 1 7248 | | A E E E | 81 52 | | CLOSED LOOP | LOOP MACHINING | |
| * | | | MATERIAL | APP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| * * | | | TITANIUM | AIR | AIRCRAFT | | TURBINE ENGINES | TURNING |
| | | | | | | _ | MID-FRAME | IN-PROCEGG CONTROL |

ETAL REMOVAL

| | | | YEARS OF | 1 | | |
|---|----------|-------------------|----------------------------------|----------|--|------------------------|
| * | | EFFORT NO SERVICE | FUNDING BITTER | JS TITLE | | |
| • | * 81#246 | AIR FORCE | 7.8 | MT FUR | MT FUR PRODUCTION MACMINABILITY DATA AND DATA BASE STRUCTURE | NO DATA BASE STRUCTURE |
| | | MATERIAL | APPLICATION | NO. | COMPONENT | SPECIFIC PROCESS |
| | | TITANIUM | TITANIUM AIRCRAFT AIRFRAME STRUC | | TURES | DATA GENERATION |

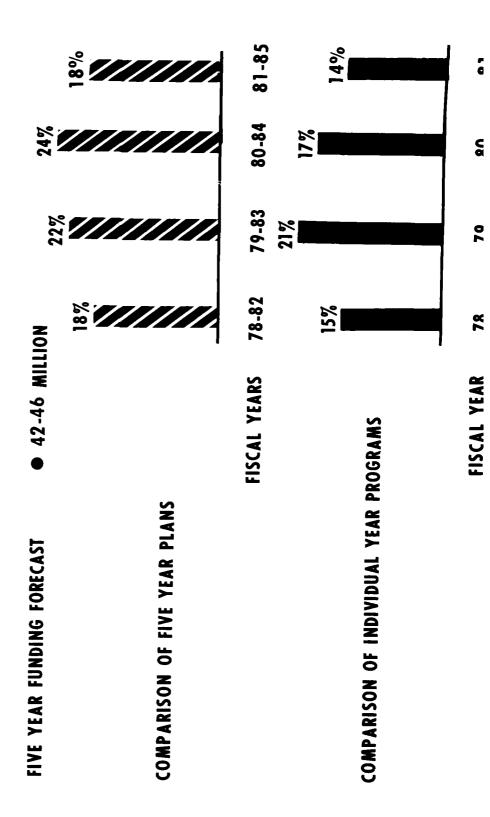
METAL REMOVAL

FUTURE SUBCOMMITTEE ACTIVITIES

- INVESTIGATE POSSIBILITY OF JOINT ARMY/AIR FORCE PROGRAM FOR LASER **ASSISTED MACHINING**
- INVESTIGATE POSSIBILITY OF JOINT ARMY/AIR FORCE PROGRAM FOR IN-PROCESS INSPECTION AND CONTROL
- INVESTIGATE POSSIBILITY OF JOINT ARMY/AIR FORCE PROGRAM FOR HIGH SPEED **MACHINING OF ALUMINUM**

JOINT PROGRAMS FOR LASER ASSISTED MACHINING, IN-PROCESS INSPECTION AND CONTROL, THE ARMY AND AIR FORCE WILL MEET TO DISCUSS THE POSSIBILITIES OF FORMING AND HIGH SPEED MACHINING OF ALUMINUM.

JOINIOS



IN THE JOINING AREA, THE FIVE YEAR FORECAST PROJECTS EXPENDITURES OF BETWEEN 42 TO 46 MILLION DOLLARS. THE COMPARISON OF THE FIVE YEAR PLANS THIS IS ALSO EVIDENT IN THE COMPARISON OF THE INDIVIDUAL YEAR PROGRAMS. SHOWS THE BEGINNING OF A DECREASE IN THE LEVEL OF EFFORT FOR JOINING. WHETHER THIS TREND WILL CONTINUE IS UNCLEAR.

DOINIOC

TECHNICAL OBJECTIVES

REDUCE FILLER MATERIAL USAGE

■ INCREASE DESIGN FLEXIBILITY

■ INCREASE SERVICE LIFE

■ INCREASE DEPOSITION RATES

■ REDUCE DISTORTION

■ INCREASE THE DEGREE OF AUTOMATION

FILLER MATERIAL USAGE, INCREASE DESIGN FLEXIBILITY, INCREASE SERVICE LIFE, INCREASE DEPOSITION RATES, REDUCE DISTORTION AND INCREASE THE THE TECHNICAL OBJECTIVES BEING SOUGHT IN JOINING ARE TO REDUCE DEGREE OF AUTOMATION.

JOINING FREQUENCY SPECIFIC PROCESS

|--|

THE SPECIFIC JOINING PROCESSES AND THE NUMBER OF PROJECTS INVOLVED IN EACH PROCESS ARE SHOWN ON THIS CHART.

FY81 PROGRAM REVIEW

● 20 PROJECTS REVIEWED

OCOMMON AREAS IDENTIFIED

HIP BONDING

DIFFUSION BONDING

AUTOMATION OF CONVENTIONAL WELDING

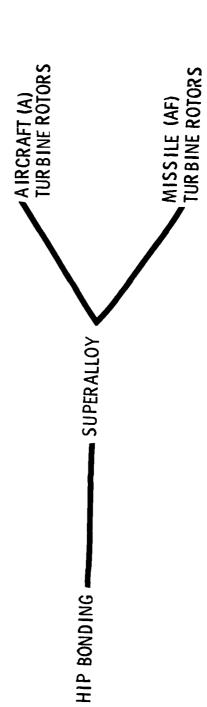
HIGH ENERGY BEAM WELDING

THE SUBCOMMITTEE REVIEWED 20 FY81 PROJECTS AND IDENTIFIED HIP BONDING, DIFFUSION BONDING, AUTOMATION OF CONVENTIONAL WELDING, AND HIGH ENERGY BEAM WELDING AS THE COMMON AREAS OF INTEREST AMONG THE SERVICES.

PROCESS

MATERIAL

APPLICATION



THE ARMY AND AIR FORCE ARE ESTABLISHING HIP BONDING AS A METHOD FOR FABRICATING DUAL PROPERTY ROTORS.

MATERIAL **PROCESS**

APPLICATION

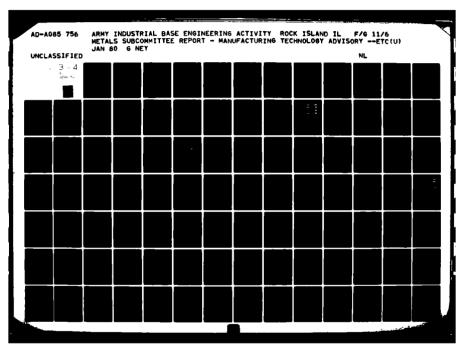
TRANSPIRATION COOLED COMPONENTS (A) TUR BINE BLADE TIPS (N) (AF) SUPERALLOY DIFFUSION BONDING

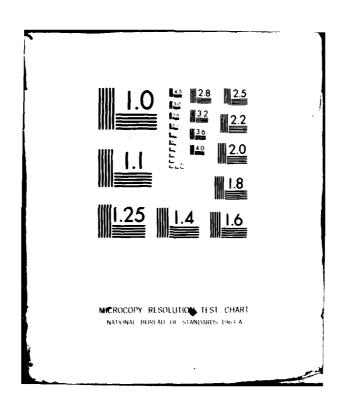
IHE NAVY AND AIR FORCE ARE JOINTLY PURSUING A PROGRAM FOR APPLYING TIPS TO TURBINE BLADES. THE ARMY AND AIR FORCE ARE JOINTLY PURSUING A PROGRAM FOR MAKING TRANSPIRATION COOLED COMPONENTS.

PROCESS MATERIAL

APPLICATION

SHIPS (N) ARMOR (A) AUTOMATION OF CONVENTIONAL WELDING PROCESSES WHILE THE NAVY AND ARMY ARE PROPOSING DIFFERENT PROGRAMS DEALING WITH AUTOMATION OF CONVENTIONAL WELDING PROCESSES, THESE PROGRAMS OFFER AN OPPORTUNITY TO POSSIBLY DEVELOP A JOINT PROGRAM.





PROCESS

MATERIAL

APPLICATION

HIGH ENERGY BEAM WELDING (LASER AND ELECTRON BEAM)

SUBMARINE HULLS (N)

ARMOR (A)

ENGINE AND
POWER TRAINS (A)

MISSILE CONTAINERS (A) - LAND VEHICLE (A) A IRFRAME (N) ALUMINUM TITAN IUM STEEL .

ELECTRON BEAM WELDING. IN OUR REVIEW WE FOUND NO DUPLICATION OF EFFORT. VARIOUS PROJECTS ARE BEING PURSUED IN THE APPLICATION OF LASER AND

FY80 PROGRAM CHANGES REVIEW

■ 4 NEW PROJECTS REVIEWED

■ COMMON AREAS IDENTIFIED

NO NEW AREAS

THE SUBCOMMITTEE REVIEWED 4 NEW FY80 PROJECTS AND IDENTIFIED NO NEW COMMON AREAS THAT HAD NOT ALREADY BEEN IDENTIFIED IN THE REVIEW OF THE FY81 PROJECTS.

AND BUDGET PROJECTS WHICH HAVE BEEN CLASSIFIED AS JOINING. THE PROJECTS HAVE BEEN SORTED BY THE MATERIALS BEING JOINED AND BY ITS APPLICATION. THE FOLLOWING COMPUTER PRINTOUT LISTS ALL ACTIVE, APPORTIONMENT,

| : | ! | | YEARS UF | | | | |
|-----|---------------|-----------|---|----------|---|---------------------|--|
| • | EFFORT NO | SERVICE | FUNDING STATUS | S TITLE | | | |
| | 1 7055 | ARMY | 7.8 | ULTRAS | ULTRASUNIC WELDING OF MELICOPTER FUSELAGE STRUCTURES | FUSELAGE STRUCTURES | |
| | | MATERIAL | APPLICATION | NO | COMPONENT | SPECIFIC PROCESS | |
| | | ALUMINUM | UMINUM AIRCRAFT AIRFRAME SECONDANY SIRU | | AIRFRAME BECONDANY BIRUCTURES | MELDING, ULTRABONIC | |
| : | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | 18 TITLE | | | |
| | 61M208 | AIR FURCE | 7 4 9 0 | H FOR | PRODUCTION DEMONSTRATION OF A-10 WELDBOND | F A=10 MELDBONO | |
| | | MATERIAL | APPLICATION | NO | COMPONENT | SPECIFIC PROCESS | |
| | | ALUMINUM | UMINUM AIRCRAFT AIRFRAMES FUSELAGE MID : COCKPIT SIDE | | AIRFRAMES FUSELAGE MID SEC PANELS COCKPIT SIDE PANELS | MELDBOND | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | 18 TITLE | | | |
| : . | UNS00551 | × > 4 × | 10 | PICLE | BATTERY FABRICATION | | |
| | | MATERIAL | APPLICATION | NO. | COMPONENT | SPECIFIC PROCESS | |
| | | ALUMINUR | AMUNITION | ×. | BATTERY, TORPEDO BARRIER | COATING, EPOXY GLUE | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | 13 TITLE | | | |
| | 1 5006 | ARMY | 60 | 1911 | HIGH POWER ELECTRON BEAM MELDING | | |
| | | MATERIAL | APPLICATION | NO | COMPONENT | SPECIFIC PROCESS | |
| | ı | ALUMINUM | LAND VEHICLES | וכרפס | HULL | MELDING, EB | |

| | | IFIC PANCESS | ING, RB ING, MIG ING, 416 | | | SPECIFIC PROCESS | | | | FIC PROCESS | SIN 'SK | | TURE | SPECIFIC PROCESS | NG, DIFFUSION |
|---------------------|----------------------------------|--------------|---------------------------------|---------------------|--------------------------------|------------------|---|---------------------|---------------------------------------|-------------|---|---------------------|---|------------------|----------------------------------|
| | MEAVY ALUMINUM PLATE FABRICATION | COMPONENT | TELDING, MELDING, MELDING, | VEARS OF TITLE | MT FOR ALUMINUM HEAT EXCHANGES | COMPONENT | DESIGNATION ALGORITHM AND | | ALUMINUM MIG ARGON-OXYGEN GAS MIXTURE | COMPONENT | SUPERSTRUCTURE MELOING, | | HIGH PRODUCTION FLUIDIC CIRCUIT MANUFACTURE | COMPONENT | FLUIDIC CONTROL SYSTEMS BONDING, |
| 7176 | MEAVY ALUM | ŽO. | S HULL | | MT FOR ALU | X 00 | HEA | TITLE | ALUMINUM M | HO0 | SELPS SELECTION | TITLE | HIGH PRODUC | COM | FLU |
| STATUS | | APPLICATION | LAND VEHICLES | STATUS | | APPLICATION | MISSILES | STATUS | | APPLICATION | GEIPO | STATUS | | APPLICATION | AIRCRAFT |
| YEARS OF FUNDING | 0 0 | • | ٠, | VEARS OF FUNDING | 79 | ₹ | X | YEARS OF FUNDING | 10 | ₹ | | YEARS OF FUNDING | 0 | 4 | ₹ |
| SERVICE | ARMY | MATERIAL | | | AIR FORCE | MATERIAL | ALUMINUM | SERVICE | NAV | MATERIAL | ALUMINUM | SERVICE | *** | MATERIAL | 9R 4 58 |
| EFFORT NO | 1 5091 | | | EFFORT NO | 92#229 | | | EFFORT NO | 0×800665 | | | EFFORT NO | ONA00651 | | |
| | • • | * | * * * | | | * | | : | | • | . ! | | • | : | * 1 |

| : | | ! | VEARS OF | ! | | | | | |
|-----|-----------|---------------|------------------------|-------------|-----------|--|---|----------------------|------------------|
| | EFFORT NO | SERVICE | | STATUS | TITLE | | | | |
| | 6 8035 | AB K A | 0 - 0 | | COATING T | UBE SUPPORT | COATING TUBE BUPPORT SLEEVES WITH BEARING MATERIALS | BEARING P | ATERIALS |
| ; | | MATERIAL | d | APPLICATION | 3 | COMPONENT | | SPECIFIC | PROCESS |
| | | BRONZE | 132 | EEAPONS | 79 | NZE BEAPONS GUN MOUNTS | | MELDING, Brazing, | MIG INDUCTION |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| :. | DN300642 | *** | 7. | | BATCH VAP | BATCH VAPOR SOLDERING | | | |
| • | | MATERIAL | Ĭď | APPLICATION | 0 | COMPONENT | | SPECIFIC PROCESS | PROCESS |
| | | OTHER | 96.II9 | Se I H | | PC BOARDS FLEXIBLE WIRING | 9 | BOLDERING, VAPOR | . VAPOR |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| :. | 1 7114 | ARMY | 11 | | IMPROVED | WFG TECH FOR | IMPROVED WIG TECH FOR INFARED SUPPRESSION ON AIRCRAFT | PRESSION C | N AIRCRAFT |
| ; | | MATERIAL | Ā | APPLICATION | 2 | COMPONENT | | SPECIFIC | PRICESS |
| | | STEEL | IV | AIRCRAFT | 52 | EL AIRCRAFT TURBINE ENGINES INFARED SUPPRESSOR | #0 0 0 | BRAZING | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | 1 7326 | A R R X | 62 01 | | ELECTRON | BEAM/INERTIA | ELECTRON BEAM/INERTIA WELD REPAIR BPLINE SMAFTS | SPLINE ST | 14718 |
| : | | MATERIAL | AP | APPLICATION | 5 | COMPONENT | | SPECIFIC PROCESS | PROCESS |
| ١., | | STEEL | 114 | AIRCRAFT | 39 | GEAR/SPLINE REPAIR | PAIR | ES WELDING | 16 |
| | | | | | T . | TRANGELORIONS | | | |

| : | | | | | | | | | |
|---------------|--|---|--|-------------|--------|---|--------------|------------------|---------------------|
| | EFFORT NO | SERVICE | FUNDING | STATUS | TITLE | | | | |
| e e e e | DN800537 | NAV | 91 | | HIGH F | HIGH FREQUENCY REGISTANCE MELDING | ACE WELDING | | |
| | | MATERIAL | AP | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | PROCESS |
| | ANN STEEL ST | | Z V | AMMUNITION | | AMMUNITION SHELL, TORPEDU | | WELDING, | WELDING, RESISTANCE |
| ; | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | 184134 | AIR FORCE | 91 | | MT FOR | MT FOR MARD STRUCTURE MUNITION WARMEAD | AUNITION WAS | PHEAD | |
| | | MATERIAL | APA | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | PROCESS |
| | | STEEL | • | ARECNITION | | AMMUNITION MARMEAD STRUCTURE MARD | | | |
| | EFFOR | | | STATUS | TITLE | | | | |
| | 8 8 8 8 | 4 7 7 | 77 | | 800 F | BODY FOR M42/M46 GRENADE | J | | |
| | | MATERIAL | AP | APPLICATION | | COMPONENT | | SPECIFIC | PROCESS |
| | | STEEL | Ĭ | AMMUNITION | | METAL PARTS | | FORGING, | COLD |
| ! | | • | | | • | PROJECTILES | | 9 | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | 5 6725 | ARMY | 7.6 | | AUTOMA | AUTOMATED INERTIA BANDING MACHINE FOR ARTILLERY MUNITIONS | ING MACHINE | FOR ARTIL | LERY MUNITIONS |
| | | MATERIAL | A A | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | PROCESS |
| | | STEEL | ¥ | AMMUNITION | | METAL PARTS | | MELDING, INERTIA | INERTIA |
| | | | | | | PROJECTILES | | | Ę |

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|-----|-----------|----------|---------------------|---------------|----------|---|---|
| : . | 5 6642 | ARMY | 2 | | INERTIA | INERTIA WELDED ROTATING BANDS FOR | OR PROJECTILE BODIES |
| ; | | MATERIAL | APA | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | 94EEL | EEL AMMUNITION | AMMUNI TION | | METAL PARTS PROJECTILES ROTATING BANDS | HELDING, INERTIA |
| | EFFORT NO | _ | YEARS OF FUNDING | STATUS | | | |
| | 1 6007 | > Z& < | 62 81 | | SUBMERG | SUBMERGED ARC WELDING USING POWDERED METALS | DERED METALS |
| : | | MATERIAL | APP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | LAN | LAND VEHICLES | | EL LAND VEHÍCLES ARMOR | WELDING, SUBMERGED ARC POWDER METAL FILLER |
| | EFFURT ND | | YEARS OF FUNDING | STATUS | TITLE | | |
| | 7 6053 | A | 2 → N M Ci | | #ELDING | RELDING SYSTEMS INTEGRATION | |
| ; | | MATERIAL | 844 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL. | LAN | LAND VEHICLES | 6 | LAND VEHICLES ARMOR | ARC FUSION PROCESSES ALTOMATION |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | T 6038 | ARMY | 79 | | HIGH DE | HIGH DEPOSITION WELDING PROCESSES | ES FOR ARMOR |
| 3 | | MATERIAL | dd v | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | | LAND VEHICLES | | ARMOR | MELDING, SUBMERGED ARC PONDER METAL FILLER |

| EFFORT NO SERVICE T 4575 ARMY T 4557 ARMY T 4392 ARMY ATERIA STEEL | # # | | 1 | | YEARS OF | • | i | | |
|--|--------|-----------|---|----------|-----------------------|------------|--------------|-------|---|
| EFFORT NO SERVICE T 4557 ARMY MATERIA SFFORT NO SERVICE T 4392 ARMY MATERIA SFFORT NO SERVICE T 5085 ARMY MATERIA SFEL | 1 | EFFORT NO | 9 | SERVICE | FUNDING | STATUS | | TITLE | TITLE |
| BTEEL LAND VEHICLES EFFORT NO SERVICE FUNDING STATUS T 4557 ARMY THARS OF STATUS T 4392 ARMY THARS OF FUNDING STATUS T 4392 ARMY TEARS OF FUNDING STATUS T 5085 ARMY T 5085 A | | 1 4575 | | A B B A | 44 | | ت | A SER | LASER MELDING TECHNIQUES FOR MILITARY VEHICLES |
| EFFORT NO SERVICE FUNDING STATUS T 4557 ARMY 77 HATERIAL APPLICATION STEEL LAND VEHICLES T 4392 ARMY 76 MATERIAL APPLICATION STEEL LAND VEHICLES T 5085 ARMY 78 MATERIAL APPLICATION STEEL LAND VEHICLES T 5085 ARMY 77 MATERIAL APPLICATION STEEL LAND VEHICLES | , | | | | 14 | LICATION | | | COMPONENT |
| FFORT NO SERVICE FUNDING STATUS T 4557 ARMY 77 MATERIAL APPLICATION STEEL LAND VEHICLES T 4392 ARMY 76 MATERIAL APPLICATION STEEL LAND VEMICLES T 5085 ARMY 78 T 6085 ARMY 78 T 6085 ARMY 78 T 6085 ARMY 78 T 78 T 6085 ARMY 78 T 78 T 6085 ARMY 78 T | | | į | : | | 10 VEHICLE | | į | ARKOR |
| FFURT NO SERVICE FUNDING STATUS T 4392 ARMY 76 EFFORT NO SERVICE FUNDING STATUS T 4392 ARMY 76 EFFORT NO SERVICE FUNDING STATUS T 5085 ARMY 78 T 6085 ARMY 78 T 6085 ARMY 78 T 6085 ARMY 78 T | | EFFORT N | g | | TEARS OF FUNDING | STATUS | TITLE | 141 | w |
| STEEL LAND VEHICLES FFURT NO SERVICE FUNDING STATUS. T 4392 ARMY 76 FFORT NO SERVICE FUNDING STATUS. T 5085 ARMY 78 T 5085 ARMY 78 STEEL LAND VEHICLES T 5085 ARMY 78 T 5085 ARMY 78 T 5085 ARMY 78 STEEL LAND VEHICLES | | 1 4557 | | ARMY | | | IDII | للما | HIGH EFFICIENCY JOINING OF ESR ARMOR |
| EFFURT NO SERVICE FUNDING STATUS. T 4392 ARMY 76 MATERIAL APPLICATION STEEL LAND VEHICLES T 5085 ARMY 78 T 5085 ARMY 78 STEEL LAND VEHICLES | | | | | Ā | LICATION | | | COMPONENT |
| FFORT NO SERVICE FUNDING STATUS. T 4392 ARMY 76 MATERIAL APPLICATION STEEL LAND VEHICLES T 5085 ARMY 78 T 5085 ARMY 78 STEEL LAND VEHICLES | | | | ï | 1 1 1 1 1 | 10 VEHICLE | | | ARKOR |
| TO APPLICATION LAND VEHICLES VEARS OF FUNDING STATUS 78 71 APPLICATION LAND VEHICLES | | EFFORT N | 9 | | | STATUS | TITLE | | |
| VEARS OF STATUS TO APPLICATION LAND VEHICLES LAND VEHICLES | | 1 4392 | | ARHY | 76 | | NINIOS | G | JOINING DISSIMILAR METALS |
| TAND VEHICLES VEARS OF STATUS 78 77 APPLICATION LAND VEHICLES | | | | MATERIAL | idv | LICATION | | | COMPONENT |
| YEARS OF STATUS 78 77 APPLICATION LAND VEHICLES | | | | | LA! | D VEHICLE | 9 | • | HULL/BODY ARMOR |
| 78 77 APPLICATION LAND VEHICLES | | EFFORT N | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| MATERIAL APPLICATION STEEL LAND VEHICLES | | T 5085 | | A B B A | 77 | | P 800 | | PROD TECH FOR FAB OF TURBINE ENGINE RECUPERATOR |
| STEEL LAND VEHICLES | | | | - | AP | LICATION | | | COMPONENT |
| | | | | STEEL | LA | ID VEHICLE | 92 | | TURBINE ENGINES RECUPERATOR |

| e e | | | 14 20 44 66 | YEARS OF | 811444 | <u>u</u> | |
|--------|---|-------------|----------------------|---------------------|-------------|-----------------------------------|--|
| * | ב ועם היים היים היים היים היים היים היים הי | | 4 • • | | 5 | | |
| * | R 1052 | ARK | • | | | ACCOUNTS ENTROPION OF NOTOR CANES | |
| | | , V | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | 0 0 0 0 0 | | STEEL | O I I | MISSILES | MISSILES ROCKET HOTOR CASES | ACOUSTIC EMISSION INSPEC |
| : | EFFORT NO | | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| | R 3441 | A A A | > | 96 | | APPLICATION OF MIGH ENERGY LAS | MIGH ENERGY LASER MANUFACTURING PROCESSES |
| | | A X | MATERIAL | APP | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | 310 | STEEL | 8 H H | AIGGILEG | MIGGILLE CONTAINERS | *ELDING, LAGER |
| | EFFORT NO | | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| :. | DN800274 | > Y | > | 0 | 2 | COMPUTERIZED WELDING | |
| | | ¥ | MATERIAL | 444 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| * | | <u></u> | STEEL | O d I HO | 6 | SHIPS HULLS | ARC FUSION PROCESSES Automation Computer Control |
| | EFFORT NO | ı | ı | YEARS OF FUNDING | STATUS | TITLE | |
| * * | 0800389 | > 42 | > | 10 | | SLAG/FLUX WELD SYSTEM | |
| , | | ¥ | MATERIAL | APA | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | | | 86 | SILOR | ARC FUSION PROCESSES |

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
|---------------|--------------------------------------|----------|---------------------|--|---------|---|------------------|---------------------|
| * * * * | DNS00405 | NAV | 2 | | NARROW | GAP WELDING | | |
| | | MATERIAL | AP | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | 8 9 9 9 9 9 | STEEL | X0 | 00 H T 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | WELDING, | WELDING, NARROW GAI |
| | EFFORT NO | M | YEARG OF FUNDING | STATUS | TITLE | | | |
| * | DNS00591 | ×> V | 0.0 | | MECHAN | MECHANIZED MATERIAL APPLICATION | | |
| • | | MATERIAL | Ā | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | 0 0 0 0 0 0 0 0 | STEEL | Ĭ 0 | 9 d H T 6 | | SHIPS HULLS RUBBER TILES | BONDING | BONDING, ADHESIVE |
| • | EFF DRT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| * * | DN800 6 50 | × × × | 81 | | MAGNET | MAGNETIC FURMING MACHINE FOR ROLLING BOILER TUBES | LLING BOILER | 1 TUBES |
| : | | MATERIAL | έdΥ | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | | STEEL | 主の | O G II I I | | STEEL STIPS | MECHANIC | MECHANICAL JOINING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | DN800666 | > < Z | 0.1 | | MULTIPL | MULTIPLE MODE WELDING SYSTEM | | |
| ; | | MATERIAL | API | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | | STEEL | TO | SELES | | のコピコーソコなーの | WELDING | |
| | | | | 1 1111 | | | | |

| | EFFORT NO | SERVICE | YEARS OF Funding | STATUS | TITLE | | | |
|-------|-----------|------------|---------------------|-------------|---------|--|----------------------|--------------------|
| | DNS00687 | NAV | 0 | 2 | DISSIM | DISSIMILAR METAL PIPE PENETRATORS | •• | |
| : | | MATERIAL | APA | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | | STEEL | | • | ; ; | PIPE PENETRATORS | WELDING, | WELDING, EXPLOSIVE |
| : | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | 011125 | AIR FORCE | ୦ ୯ ଶ ଷ | | M FOR | COINING OF PA DISKS | | |
| | | MATERIAL | APA | APPLICATION | | COMPONENT | SPECIFIC | PROCESS |
| | | SUPERALLOY | RIA | AIRCRAFT | | SUPERALLNY AIRCRAFT TURBINE ENGINES COMPRESSOR ROTOR | *9NI QNO8 | BONDING, DIFFUSION |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | DNA00747 | NAVY | © | | CORRUSI | CORRUSION RESISTANT TURBINE BLADE TIPS | E TIPS | |
| | | MATERIAL | dd v | APPLICATION | | COMPONENT | SPECIFIC | PROCESS |
| | | SUPERALLOY | | AIRCRAFT | | AIRCRAFT TURBINE BLADES | BONDING, HELDING, | DIFFUSION TIG |
| | EFFORT NO | GERVICE | 8 0 | STATUS | TITLE | | | |
| | 91H262 | AIR FORCE | 70 | D | HT FOR | REPAIR OF KNIFE EDGE SEALS | • | |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| • • • | | SUPERALLOY | | AIRCRAFT | | TURBINE ENGINES OFFIG KNITE EDGE NOTOR COMPRESSOR | | |

| - | | | | | | | |
|----------|--|---------------------------------|---|------------------|--|------------------|-----------------------|
| | EFFURT NO | SERVICE | YEARS OF STATUS | TITLE | | | |
| | 11 #208 | AIR FORCE | 30 00 00 10 | MT FOR | MT FOR TRANSPORATION COOLED AIRFOILS | 8118 | |
| | | MATERIAL | APPLICATION | | COMPONENT | SPECIFIC | PROCESS |
| • | | SUPERALLOY | . AIRCHAFT | | VANES | BONDING | a II I |
| ! | • • • • • • • • • • • • • • • • • • • | 0 2 3 4 0 0 0 | 8 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 | | BLADEG TCABINE ENSINES | | |
| | EFFONT NO | SERVICE | VEARS OF FUNDING STATUS | TITLE | | | |
| . | 02#205 | AIR FORCE | 00 00 10 | MT FOR | MT FUR AUVANCED VANE AND COMBUSTOR FABRICATION FOR SMALL ENGINES | R FABRICAT | ION FOR SMALL ENGINES |
| | | MATERIAL | APPLICATION | | COMPONENT | SPECIFIC | PROCESS |
| | | SUPERALLOY | AIRCRAFT | | TURBINE ENGINES | | |
| | | 4 | | | VANES TURBINE Combustor | | DIFFUSION |
| | EFFORT 40 | SERVICE | VEARS OF FUNDING STATUS | TITLE | | | |
| . | 014207 | AIP FORCE | 80 80 1.0 | MT FUR | HT FUR ABRASIVE BLADE TIPS | | |
| : | | MATERIAL | APPLICATION | | COMPONENT | SPECIFIC PROCESS | PROCESS |
| | ## 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | SUPERALLOY | Y AIRCRAFT | 1 1 1 1 | TURBINE ENGINES BLADE TURBINE | 941×105 | |
| | EFFURT NU | SERVICE | YEARS OF FUNDING STATUS | TITLE | | | |
| | 1 7197 | 4 7 | 9 7 7 7 9 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 1 8 | FABRICA | FABRICATION OF INTEGRAL ROTORS BY JOINING | 9NINICO | |
| ; | | MATERIAL | APPLICATION | | COMPONENT | SPECIFIC | PROCESS |
| | | SUPERALLOY | PERALLOY AIRCRAFT TURBINE ENGINE | | TURBINE ENGINESS ROTORS | BUNDING | a. II |
| | | | | | | | |

| | €0 | SPECIFIC PROCESS | 90N0 I NG | | BUSTOR LINER | SPECIFIC PROCESS | BONDING, DIFFUSION PHOTO ETCHING | | | | SPECIFIC PROCESS | BRAZING | | IBINE WHEEL | SPECIFIC PROCESS | CABTING | BONDING, MIP |
|-----------|------------------------------------|------------------|---------------------------------|---------------------|---|------------------|-------------------------------------|------------|---------------------|--------------------------------|------------------|--|------------------|---|------------------|-----------------|---------------|
| OOINING | ABRADABLE SEALS FOR TURBINE BLADES | COMPONENT | TURBINE ENGINES TURBINE BELADES | | LOM COST TRANSPIRATION-COOLED COMBUSTOR LINER | COMPONENT | TURBINE ENGINES | COMBUSTOR | | HT FOR REAIR OF OOS COMPONENTS | COMPONENT | SUPERALLOY AIRCRAFT TURBINE ENGINES BLADES VANES | | HT FOR DUAL PROPERTY INTEGRAL TURBINE WHEEL | COMPONENT | TURBINE ENGINES | は上午のこ しいののととの |
| TITLE | ABRADABI | | | TITLE | LOW COS | | | | TITLE | MT FOR | | | TITLE | MT FOR | | | |
| STATUS | | APPLICATION | AIRCRAFT | STATUS | | APPLICATION | AIRCRAFT | | STATUS | | APPLICATION | A I RCRAFT | STATUS | | APPLICATION | MISSILES | |
| YEARG CO | 79 | 4 d v | AIR | YEARS OF Funding | | 14 | A16 | | YEARS OF FUNDING | 9 1 | 4 | 14 | YEARS OF FUNDING | 77 | 4 | H | |
| SERVICE | ₽ ₽ ₹ | MATERIAL | SUPERALLOY | SERVICE | Α Σ > | MATERIAL | SUPERALLOY | | SERVICE | AIR FORCE | MATERIAL | SUPERALLOY | SERVICE | AIR FORCE | MATERIAL | SUPERALLOY | |
| EFFORT NO | | | | EFFORT NO | 1 7322 | | | | EFFORT NO | 118245 | | | EFFORT NO | 72M269 | | | |
| : | : | | . | ! | | | : | * * | | : | | • | | : | | :. | |

| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | 111.5 | |
|-----|-----------|----------------------------|---|---|---------------------------------|
| | 114113 | AIR FORCE | 9 5 5 5 6 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 | MT FOR SCALE-UP OF NON-COBALT WELDABLE ALLOYS | LOABLE ALLOYS |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | SUPERALLOYS | YS AIRCRAFT | TURBINE ENGINES | WELDING, 71G Welding, Plabma |
| | | 0 0 0 0 0 0 | | OF ADEO | _ |
| ; | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | TITLE | |
| : . | DNA00680 | > V | 79 | EB WELDED MIP STRUCTURES | |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | TITANIUM | AIRCRAFT | AIRCRAFT AIRFRAME STRUCTURES NACELLE | EB WELDING |
| | EFFURT NO | 1 | YEARS UF FUNDING STATUS | TITLE | |
| : . | 114219 | AIR FURCE | 91 | MI FOR REPAIR OF SPF/DB PANELS | |
| ; | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | TITANIUM | AIRCRAFT | DOOR, MAIN LANDING STRUT | REPAIR OF SPF/DB PANELS |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | 717LE | |
| | 1 7054 | ARHY | 76 | DIFFUSION BONDED TITANIUM SPAR FABRICATION | ABRICATION |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | TITANIUM | AIRCRAFT | ROTOR SYSTEM BLADE/SPAR | BONDING, DIFFUSIUN, SEAM |

| * * | | | | | | | | | | |
|-----|---|---|-----------|---------------------|-------------|--------|--|--------------|-------------------|---------------|
| | EFFORT NO | 9 | SERVICE | FUNDING | STATUS | TITLE | | | | |
| | 514871 | | AIR FURCE | 22 | | HT FOR | MT FOR SHROUDED BLADE FABRICATION | ABRICATION | | |
| , | | | MATERIAL | API | APPLICATION | | COMPONENT | ₩ | SPECIFIC PROCESS | PROCESS |
| | N Z V L I L L L L L L L L L L L L L L L L L | i | TITANIUM | IV | AIRCRAFT | • | UM AIRCRAFT TURBINE ENG BLADES | | BONDING, PRESSURE | PRESSURE |
| | EFFORT NO | 9 | SERVICE | YEARS OF Funding | STATUS | TITLE | | | | |
| :. | 718833 | | AIR FORCE | 7.0 | | MT FOR | HT FOR WELDED TITANIUM LANDING GEAR BOGIE BEAM FOR C-141 | LANDING GEAF | 4 BOGIE 8 | EAM FOR C-141 |
| | | | MATERIAL | API | APPLICATION | | COMPONENT | ₩ | SPECIFIC PROCESS | PROCESS |
| | | | TITANIUM | A I | AIRCRAFT | | BOGIE BEAM | - | HELDING | |

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SNINIOS

SUBCOMMITTEE ACCOMPLISHMENTS

- ASSESSED THE RESULTS OF THE JOINING CONFERENCE
- **ESTABLISHED A JOINT NAVY/AIR FORCE PROGRAM FOR** TURBINE BLADE TIP TREATMENT
- **ESTABLISHED A JOINT ARMY/AIR FORCE PROGRAM FOR** TRANSPIRATION COOLED COMPONENTS

FUTURE SUBCOMMITTEE ACTIVITY

- INVESTIGATE THE POSSIBILITY OF A JOINT ARMY/NAVY PROGRAM ON AUTOMATION OF CONVENTIONAL WELDING **PROCESSES**
- **WORKSHOP ON LASER MANUFACTURING TECHNOLOGY** INVESTIGATE THE POSSIBILITY OF SPONSORING A

THE SUBCOMMITTEE ASSESSED THE RESULTS OF THE JOINING CONFERENCE WHICH IT SPONSORED IN SEPTEMBER 1978, THAT ASSESSMENT IS PRESENTED ON THE NEXT CHART. THE SUBCOMMITTEE WAS RESPONSIBLE FOR CREATING A JOINT NAVY/AIR FORCE PROGRAM FOR TURBINE BLADE TIP TREATMENT AND A JOINT ARMY/AIR FORCE PROGRAM FOR TRANSPIRATION COOLED COMPONENTS.

FOR THE AUTOMATION OF CONVENTIONAL WELDING PROCESSES AND WILL INVESTIGATE THE POSSI-BEEN TWO AND A HALF YEARS SINCE WE SPONSORED THE FIRST; AND GREAT PROGRESS HAS BEEN BILITY OF SPONSORING OUR SECOND WORKSHOP ON LASER MANUFACTURING TECHNOLOGY. IT HAS THE SUBCOMMITTEE WILL INVESTIGATE THE POSSIBILITY OF A JOINT ARMY/NAVY PROGRAM WE MAKE A FINAL DECISION. FIRST, IS THE WORKSHOP NEEDED? BECAUSE OF THE INTEREST IN THIS TECHNOLOGY, THERE HAVE BEEN AND CONTINUE TO BE WORKSHOPS AND SEMINARS HELD MADE IN THIS TECHNOLOGY SINCE THEN. BUT TWO QUESTIONS NEED TO BE ANSWERED BEFORE MEETINGS CANNOT? THE SECOND QUESTION STEMS FROM THE RECOMMENDATIONS MADE AT THE MUCH TO HANDLE AT ONE WORKSHOP. THE ANSWERS TO THESE QUESTIONS WILL DETERMINE JOINING WORKSHOP. SHOULD WE EXPAND THE SUBJECT MATTER TO ALL HIGH ENERGY BEAM PROCESSES, AS THE WORKSHOP RECOMMENDED, OR WILL THIS EXPANSION IN SCOPE BE TOO ON THIS SUBJECT ON A REGULAR BASIS. WHAT CAN WE ACCOMPLISH THAT THESE OTHER

JOINING TECHNOLOGY WORKSHOP

ISSUES AND ACTIONS TAKEN

- TOO MUCH EMPHASIS BEING PLACED ON HIGH ENERGY BEAM TECHNOLOGY
- SEVERAL NEW PROGRAMS DEALING WITH CONVENTIONAL WELDING PROCESSES HAVE BEEN PROPOSED
- AUTOMATION OF CONVENTIONAL WELDING PROCESSES IS A DESIREABLE GOAL
- DOD IS NOW PURSUING THIS GOAL
- NEED INCREASED RED FOR JOINING TECHNOLOGY
- R&D PROGRAMS ARE BEING FUNDED PARTICULARLY FOR BETTER UNDERSTANDING OF CONVENTIONAL WELDING **PROCESS**
- NEED MORE DESIGN AND PROCESSING DATA
- DESIGN ALLOWABLE DATA FOR ALUMINUM WELDMENTS
- WELD REPAIR FOR TITANIUM CASTINGS

SHOP PANELS FELT THAT DOD WAS PLACING TOO MUCH EMPHASIS ON HIGH ENERGY BEAM WELDING TECHNOLOGIES. THIS SUGGESTION WAS APPARENTLY NOTED BY DOD PERSONNEL IN ATTENDANCE. THE JOINING TECHNOLOGY WORKSHOP WAS HELD IN SEPTEMBER OF LAST YEAR. ALL WORK-NO NEW HIGH ENERGY BEAM PROJECTS ARE PLANNED FOR FY80 OR FY81, AND SEVERAL CONVEN-TIONAL WELDING PROGRAMS HAVE BEEN PROPOSED.

THE PANELS RECOMMENDED THE GOAL OF AUTOMATING CONVENTIONAL WELDING PROCESSES. ARMY AND NAVY PROJECTS ARE NOW INCLUDED IN THE PROGRAM WITH THIS GOAL.

ARE NOW BEING PURSUED TO EXPAND OUR UNDERSTANDING OF CONVENTIONAL WELDING PROCESSES. WELDABLE ALLOYS AND UNDERSTANDING THE WELDING PROCESSES THEMSELVES. R&D PROGRAMS ALSO POINTED OUT WAS THE NEED FOR INCREASED R&D FUNDING FOR DEVELOPING MORE

THE NEED FOR DESIGN AND PROCESSING DATA WAS ALSO HIGHLIGHTED. SUCH EFFORTS ARE NOW BEING PLANNED BY THE ARMY AND THE NAVY.

FIVE YEAR FUNDING FORECAST

■ 18-22 MILLION

COMPARISON OF FIVE YEAR PLANS

\$ **////**

79-83

78-82

FISCAL YEARS

80-84

10%

COMPARISON OF INDIVIDUAL YEAR PROGRAMS

8

79

28

FISCAL YEAR

PLANS SHOWS A CONSTANT LEVEL OF EFFORT AS DOES THE COMPARISON OF INDIVIDUAL EXPENDITURES OF 18 TO 22 MILLION DOLLARS. THE COMPARISON OF THE FIVE YEAR IN THE SURFACE TREATMENT AREA, THE FIVE YEAR FUNDING FORECAST PROJECTS YEAR PROGRAMS.

TECHNICAL OBJECTIVES

- D INCREASE DIFFUSION/DEPOSITION RATES
- REDUCE ENERGY CONSUMPTION
- **D** REDUCE POLLUTANTS
- PROVIDE PROCESSES FOR ADVANCED COATINGS
- INCREASE CORROSION AND WEAR RESISTENCE

ARE TO INCREASE THE DIFFUSION/DEPOSITION RATES, REDUCE ENERGY CONSUMPTION, THE TECHNICAL OBJECTIVES BEING SOUGHT IN THE SURFACE TREATMENT AREA REDUCE POLLUTANTS, PROVIDE PROCESSES FOR ADVANCED COATINGS AND INCREASE CORROSION AND WEAR RESISTANCE.

FREQUENCY SPECIFIC PROCESS

- ABRASIVE PARTICLE FLOW ANODIZING
- **AQUAQUENCH**
- ARC WELD HARD FACING
- **AUTOFRETTAGE**
- CARBORIZING, VACUUM
 - CLEANING SURFACE
 - COATING
- DEPOSITION
- **ELECTRODE STRAIGHTNESS**
 - ELECTRODEPOSITION
- ELECTROPLATE, ALUMINIDE, HEAT TREATMENT
 - HEAT TREATMENT, CONT.
 - HEAT TREATMENT, LASER MAKING MANDRELS
- PLASMA SPRAY
- PLATING PLATING, CHROMIUM
 - PLATING, ION
- OUENCHING
 SHOT BLASTING
- SPRAYING, THERMOARC
- SPRAYING, ZR OXCIDE STRESS RELIEF, VIBRATORY
 - SWAG AUTOFRETTAGE

THE SPECIFIC SURFACE TREATMENT PROCESSES AND THE NUMBER OF PROJECTS ASSOCIATED WITH EACH PROCESS IS SHOWN ON THIS CHART.

FY81 PROGRAM REVIEW

●16 PROJECTS REVIEWED

DCOMMON AREAS IDENTIFIED

• ION VACUUM DEPOSITION

● LASER HEAT TREATMENT

PLASMA SPRAY

LASER HEAT TREATMENT AND PLASMA SPRAY WERE IDENTIFIED AS THE COMMON AREAS THE SUBCOMMITTEE REVIEWED 16 FY81 PROJECTS. ION VACUUM DESPOSITION, OF INTEREST AMONG THE SERVICES.

PROCESS

MATERIAL

APPLICATION

ION VACUUM DEPOSITION

STEEL -

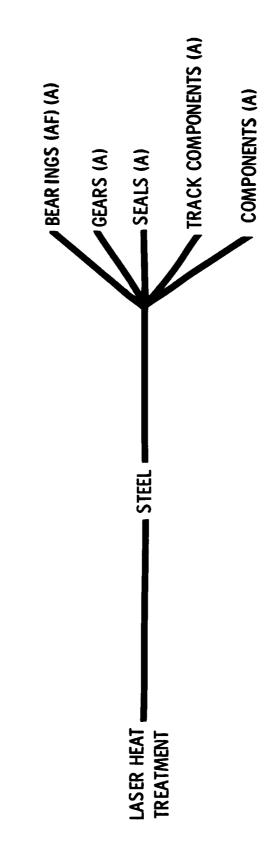
AIRFRAME
STRUCTURES (AF)
COMPONENTS (A)
ARMAMENT

THE AIR FORCE ESTABLISHED THE ION VACUUM DEPOSITION PROCESS FOR APPLYING THE ARMY'S EFFORT WILL EXTEND THE USE OF THIS PROCESS TO WEAPONS COMPONENTS. AN ALUMINUM COATING ON STEEL COMPONENTS FOR USING IN AIRFRAME STRUCTURES.

APPLICATION

MATERIAL

PROCESS



ARMY'S AND ARE APPLYING THE TECHNOLOGY TO DIFFERENT MATERIALS AND CONFIGURATIONS. TREATMENT OF BEARINGS. THE REST OF THE LASER HEAT TREATMENT PROGRAMS ARE THE ARMY AND AIR FORCE ARE JOINTLY PURSUING A PROGRAM FOR LASER HEAT

PROCESS MATERIAL

APPLICATION

PLASMA SPRAY -----SL

- SUPERALLOY -

AIR CRAFT (A)
SEALS (AF)

THE ARMY AND AIR FORCE WILL MEET TO DISCUSS THE SEALS AREA TO INSURE THAT NO DUPLICATION OF EFFORT WILL TAKE PLACE.

FY80 PROGRAM CHANGES REVIEW

3 NEW PROJECTS REVIEWED

D COMMON AREAS IDENTIFIED

D NO NEW AREAS

COMMON AREAS THAT HAD NOT BEEN IDENTIFIED IN THE REVIEW OF FY81 PROJECTS. THE SUBCOMMITTEE REVIEWED THREE NEW FY80 PROJECTS AND FOUND NO NEW THE FOLLOWING COMPUTER PRINTOUT CONTAINS ALL ACTIVE, APPORTIONMENT THEY HAVE BEEN SORTED FIRST BY MATERIAL AND NEXT BY APPLICATION, AND BUDGET PROJECTS WHICH HAVE BEEN CLASSIFIED AS SURFACE TREATMENT.

| : | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
|----|---------------------------------|----------|---|---------------|---|------------------------|
| | 6 7644 | ARRY | 11 | | APPLICATION OF INTEGRAL COLOR ANODIZE FOR ALUMINUM | DIZE FOR ALUMINUM |
| | | MATERIAL | 144 | APPLICATIUN | COMPONENT | SPECIFIC PROCESS |
| | 0 0 0 0 0 0 0 | ALUMINIM | I I I I I I I I I I I I I I I I I I I | O V D d V J z | UMALL CALIBER UTOCK RECEIVER | ANDDIZING |
| | EFFORT NO | | YEARS OF FUNDING | STATUS | | |
| | 8004 | > I & | 96 | | CO-DEPOSITION OF SOLID LUBRICANTS | DURING ANODIZING |
| : | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | ALUMINUM | W I | E A PONS | ALUMINUM WEAPONS ALUMINUM LUBRICATED SURF RECIEVERS | ANODIZING |
| , | EFFORT NO | SERVICE | YEARS OF Funding | STATUS | TITLE | |
| : | 6 6113 | > 1 2 | A2 | | ESTABLISHMENT OF ION PLATING PROCESS FOR ARMAMENT PARTS | EGG TOP ARTAIENT PARTS |
| : | | MATERIAL | AP | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| ii | | ALURINOR | Ø 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | FFPONS | RECEIVER FAGTERES LINKS | PLATING, 10W |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| | DVAB1070 | > V | 91 | | THERMAL BARRIER COATING MFG PRUCESS | S |
| ; | | MATERIAL | Ĭď. | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | CERAMIC | I | AIRCRAFT | CERAMIC AIRCRAFT THERMAL BARRIERS TURBINE ENGINES | COATING |
|) | | | | | | |

| # # | | | VEADS OF | | | | | | |
|-----|---------------------------------------|-----------|---------------------|-------------|---------|---|---------|----------------------|-----------|
| • | EFFORT NO | SERVICE | FUNDING | STATUS | TITLE | | | | |
| | 1 7143 | > I & | 8 80 12 S1 | | CERAMIC | CERARIC GAS SEAL-HIGH PRESSURE TURBINE | PESSURE | TURBINE | |
| | | MATERIAL | IddV | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | OCESS |
| | • • • • • • • • • • • • • • • • • • • | CERAMICS | AIR | AIRCRAFT | 1 | SANICO ATRICARTI ATRICARTI ODIZARI | | SPRAYING, ZR OXCIDE | R OXCIDE |
| ; | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | DNA81069 | MAVY | 81 | | COMPRES | COMPRESSOR SEAL SCALE UP | ā | | |
| | | MATERIAL | lddv | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | OCESS |
| | 0 0 0 0 0 0 0 | OTHER | AIR | AIRCRAFT | | TER TURBINE ENGINES SEALS | | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | 902410 | AIR FORCE | 0 | | MT FUR | MT FUR PRODUCTION SCALE-UP OF | | 2500 F SEAL SYSTEM | 7.E.H |
| | | MATERIAL | 1664 | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | DCESS |
| | | 01HER | AIRCRAFT | AIRCRAFT | | TURBINE ENGINES SMRCUD TURBINE | | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | 1 8129 | ≻ Eα∢ | 7.5 | | COLUMBI | COLUMBIUM ALLOY DYNAMIC TURBINE ENGINE COMPONENTS | TURBINE | ENGINE COMPONE | EN 10 |
| | | MATERIAL | Idda | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | OCESS |
| * * | | 04160 | A I RC | AIRCRAFT | | TURBINE ENGINES BLADES | | COATING OF COLUMBIUM | COLUMBIUM |
| | | | | | | | | | |

| 9 | EFFORT' NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
|--------|---------------------------------|------------|---------------------|---------------------------------|--------|--|---------|----------------------------------|------------------|
| | 5 4309-09 | > ± a < | 0 | D Z | INVEST | INVESTIGATE METHODS FOR FORMING AND HEAT TREATING THE CORE | FORMING | AND HEAT T | REATING THE CORE |
| • | | MATERIAL | A | APPLICATION | | COMPONENT | | SPECIFIC | SPECIFIC PROCESS |
| | | OTHER | I V | AMMUNITION | 1 | AMMUNITION DEPLETED URANIUM CORE | CORE | HEAT TREATMENT FORGING, UPSET | ATMENT |
| | EFFORT NO |) | YEARS OF FUNDING | STATUS | TITLE | | | | |
| R B | DN800344 | > V | 70 | | BOILER | BOILER TUBE CLEANING | | | |
| 3 | | MATERIAL | 4 | APPLICATION | | COMPONENT | | SPECIFIC | SPECIFIC PROCESS |
| | | OTHER | 80 H H 8 | 8 | | SHIPS TUBES, BOILER | | CLEANING | CLEANING SURFACE |
| | EFFORT NU | | YEARS OF FUNDING | STATUS | TITLE | | | | |
| * | DNS00667 | N A V | 10 | | METAL | METAL TREATMENT PROCESS | | | |
| 3 | | MATERIAL | d d v | APPLICATION | | COMPONENT | | SPECIFIC | SPECIFIC PROCESS |
| | 0 0 0 0 0 0 0 | OTHER | 96 L I S | 5 1 1 1 1 1 1 | 1 | | | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | 6 1746 | ARMY | 7.7 | | IMPROV | IMPROVED DURABILITY HIGH EFFICIENCY REFLECTIVE FILMS | EFFICIE | NCY REFLEC | TIVE FILMS |
| 3 | | MATERIAL | 464 | APPLICATION | | COMPONENT | | SPECIFIC PROCESS | PROCESS |
| | | | ₹ ₩ | EN A PON | | FIRE CONTROL OPTICS | | COATING | |
| ĺ | | | | | | | | | |

| | • | | | | | |
|---------|---|----------|----------------------|--|--|--|
| * * * * | EFFORT NO. 1 7199 | O Z | SERVICE ARMY | YEARS OF FUNDING STATUS 78 79 80 | TITLE Surface mardening of Gears Bearings and | AND SEALS BY LASERS |
| | * * * * * | | TATERIAL STEEL | APPLICATI AIRCRAFT | COMPONENT TRANSMISSION COMPONENTS | SPECIFIC PROCESS |
| **** | EFFURT NO 1 7298 | 2 | SERVICE ARMY | 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | N I Z I | |
| | | j | MATERIAL STEEL | | APPLICATION COMPONENT AIRCRAFT THANGRIGGION GEARS CA | OPECIFIC PROCESS CARBORIZING, VACUUM |
| | EFFORT NO. 1 8148 | 3 | GEN LICE | YEARS OF FUNDING STATUS 76 75 | EAR MATERIALO | |
| • | | | MATERIAL STEEL | APPLICATION AIRCRAFT | | SPECIFIC PROCESS |
| :. | EFFURT NO 81M232 | ģ | SERVICE AIM FORCE | YEARS OF FUNDING STATUS | LE FOR | |
| * * * * | , | | MATERIAL GTEEL | APPLICATION AIRCRAFT | | WPECIFIC PROCESS HERT TREATHENT, LABER |
| | • | | | | 的 医克里耳氏 医克里耳氏 医克里耳氏 医克里耳氏 医克里耳氏 医克里耳氏 医克里耳氏 医克里耳氏 医二甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲基苯甲 | |

| : | | | YEARS OF | | į | | |
|---|--|----------------------|---------------------|---------------|--------|--|------------------------------------|
| • | 18M237 | SERVICE AIR FORCE | | 0 | HT FOR | PLASMA SPRAYED BAND SEATS | • |
| • | | MATERIAL | | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| : | | STEEL | ¥ ¥ | AMMUNITION | | BAND SEATS | COATINGS PLASSE SPRAY |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS TIT | TITLE | · · · · · · · · · · · · · · · · · · · | |
| | 5 6678 | ARMY | 7.7 | | EVALUA | EVALUATION OF AGUAGUENCH UNDER PRODUCTION CONDITIONS | PRODUCTION CONDITIONS |
| | | MATERIAL | 444 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | 0 0 0 0 0 0 | STEEL | X | AMMUNITION | | AMMUNITION METAL PARTS PROJECTILES | ADUADUENCH |
| | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 1 5054 | A R R × | 7.9 8.0 | | LASER | SURFACE HARDENED COMBAT | HARDENED COMBAT VEHICLE COMPONENTS |
| | | MATERIAL | APA | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | LAND VEHICLES | LAND VEHICLES | 90 | TRACK BMDES CONNECTURS TRACK PINS | MEAT TREATERY, LAGER |
| ; | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | T 5086 | ARRY | 99 12 12 2 | | LASER | LAGER HARDENING OF TRANSMISSION COMPONENTS | N COMPONENTS |
| ; | | MATERIAL | 444 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | 315 315 88 88 88 88 88 88 88 88 88 88 88 88 88 | | | LAND VEHICLES | 8 | L TRANSMISSION COMPONENTS | HEAT TREATMENT, LASER |

ويحوفونه وبوريه

| | EFFORT NO | SERVICE | FUNDING | STATUS | TITLE | | |
|-----|-----------|----------------|---|---------------|-------------|---------------------------------------|----------------------|
| | T 4514 | A R K × | 4 6 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | | HARD FA | HARD FACING OF TRACK SHOES | |
| | | MATERIAL | APA | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | \v . | LAND VEHICLES | 8 | L LAND VEHICLES TRACK SHOE | ARC WELD MARD FACING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | DN800355 | NA V | 79 | | CO2 BLASTER | STER | |
| ; | | MATERIAL | yd▼ | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | GI IO | NT I DO | | TULLS | SURFACE CLEANING |
| | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 87900810 | > A | € | | COZ BLASTER | STER | |
| ` ; | | MATERIAL | AP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | (IO) | 00 I I 0 | | SAILS SAILS 1 | SHOT BLASTING |
| | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 6 7213 | ARMY | 77 | | E E E | HIGH SPEED CHRUMIUM PLATING TECMNIQUE | TECHNIQUE |
| | | MATERIAL | APF | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | 13 m | SADORS | | LARGE CALIBER | COATING CARDONALE |
| | | | | | | | |

| - | | | | YEARS OF | | | |
|---------------|-----------|----|----------|--|-------------|--|---|
| - 3 | EFFORT NO | 9 | SERVICE | FUNDING | STATUS | TITLE | |
| | 6 7241 | | ARMY | 76 | | IMPROVED HONING EQUIPMENT AND PROCEDURES | PROCEDURES |
| | | | MATERIAL | 14 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | | STEEL | 134 | MEAPONS | LARGE CALIBER | HONING |
| | EFFORT NO | 9 | SERVICE | YEARS UF FUNDING | STATUS | TITLE | |
| * | 6 7614 | | A R H Y | 7.7 | | APPLICATION OF RAPID PLATING BY ABRASIVE PARTICLE FLOW | BY ABRASIVE PARTICLE FLOW |
| | | | MATERIAL | 1dV | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | 1 | STEEL | 132 | *EAPONS | MEAPONS | PLATING, CHRUMIUM ABRASIVE PARTICLE FLOW |
| | EFFORT NO | Q | | YEARS OF FUNDING | STATUS | TITLE | |
| | 6 7655 | | ¥ & 4 | 78 | | APPLICATION OF THERMOARC SPRAY WEAR COATING | " WEAR COATING |
| | | | MATERIAL | 444 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | : | STEEL | SOUTA THE SECOND | FEAPONG . | SMALL CALIBER STOCK RECEIVER | OPRAYING, THERMOARC |
| | EFFORT NO | O. | SERVICE | YEARG OF | STATUS | TITLE | |
| # # # # | 6 7733 | | Y I & | 11 | | TUBE BREECH CLAMP | |
| | | | MATERIAL | APA | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | | STEEL | 3 | WEAPONS | LARGE CALIBER Tubes | AUTOFRETTAGE |
| | | | | | | | |

| : | EFFORT NO | SP > | YEARS OF | 814108 | TTTE | | | | | |
|---------------|------------------|---|---|-------------|------------|---|------------|-----------|---|--------|
| : | 6 7814 | ¥ # # # # # # # # # # # # # # # # # # # | 7 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 | | SYNTHETIC | COUENCHANT FI | DR HEAT | TREATING | SYNTHETIC QUENCHANT FOR HEAT TREATING WEAPON COMPONENTS | 2 - |
| | | MATERIAL | A P | APPLICATION | ט | COMPONENT | | SPEC | SPECIFIC PROCESS | |
| ! | | 376EL | MEAPONS | EEAPONG I | 9 1 | GENERAL | | PEAT | HEAT TREATMENT Quenching | |
| | EFFORT NO | SERVICE | YEARG OF | STATUS | TITLE | | | | | |
| K R H # | 0 7916 | ARH > | 91 | | APPLICATI | APPLICATION OF LOW COST MANDREL MATERIALS | ST MANDR | EL MATERI | 17.5 | |
| | | MATERIAL | ddV | APPLICATION | 3 | COMPONENT | | SPEC | SPECIFIC PROCESS | |
| | | STEEL | 4 F | PEAPONS | ONNO | CANNON TUBES | | 0 I | BWAGE AUTOFRETTAGE Making Mandrels | la! |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | | |
| * | 6 7920 | **** | 90 | | CONSERVAT | CONSERVATION OF CRITICAL MATERIALS FOR GUN TUBES | CAL MATE | RIALS FOR | 4 GUN TUBES | |
| | | MATERIAL | dd v | APPLICATION | ຽ | COMPONENT | | SPEC | SPECIFIC PRUCESS | |
| | • • • • | STEEL | A | E A POZOS | | CANNON TUBES | | FOR | HEAT TREATHENT Forging | |
| • | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | | |
| , i | ***** | A RR Y | 80 61 | v s | Ynergisti(| SYZERGISTIC PLATINGS WITH INFUSED LUBRICANTS | TH INFUS | ED LUBRIC | DAN TO | |
| | | MATERIAL | dd▼ | APPLICATION | ວັ | CUMPONENT | | SPEC | SPECIFIC PROCESS | |
| | | STEEL | · · · · · · · · · · · · · · · · · · · | EM A DONO | ננ | STEEL REAPONS LOW WEAR BURFACES LOW WEAR BURFACES | CESURFACES | PLAT | PLATING | |
| ļ | 1 1 1 1 1 1 1 1 | THE PROPERTY | | 1 1 1 | | | | | | |

| DR. | 6 8001 ARMY MATERI. STEEL STEEL EFFORT NO SERVICE | ERVICE RMY MATERIAL STEEL | FFORT NO SERVICE FUNDING STATES OF SERVICE FUNDING STATES OF SERVICE FUNDING STATES OF SERVICE FUNDING STATES | | ATUS TITLE RAPIO FLOW PLATING OF SMALL CALIBER GUN TUBES ATION COMPONENT SPECIFIC PR S GUN TUBES, SMALL CALIBER COATING ATUS TITLE | F SMALL CALIB | SPECIFIC PROCESS COATING PLATING |
|--------|---|------------------------------------|---|-------------|--|---------------|----------------------------------|
| 9008 9 | ◀ | _ | 79 | | ESTABLISHMENT OF THE MECHANICAL PLATING PROCESS | MECHANICAL P | LATING PROCESS |
| | HAH | MATERIAL | 994 | APPLICATION | COMPONENT | | SPECIFIC PROCESS |
| | STEEL | 13: | | WEAPONS | GENERAL | | DEPOSITION COATING |
| יאט. | EFFURT NU SERVICE | /ICE | YEARS OF FUNDING | STATUS | 7176 | | |
| 9208 9 | ARMY | | 0 | | APPLICATION OF SYNTHETIC QUENCHANTS TO GUN TUBES AND HEAVY WEAPON COMPONENTS | TIC DUENCHAN | ITS TO GUN TUBES |
| | HAH | MATERIAL | 4 | APPLICATION | COMPONENT | | SPECIFIC PROCESS |
| | 2 | | MEAPON | | BARRELO, CANNON | ۲. | HEAT TREATMENT |
| URT | EFFURT NO SERVICE |) I C E | YEARG OF FUNDING | STATUS | TITLE | | |
| 6 6059 | ARA | | 0 | 2 | SALVAGE OF CANNON COMPONENTS BY ELECTRODEPOSITION | PONENTS BY E | LECTRODEPUSITION |
| | TAR | MATERIAL | d ◀ | APPLICATION | COMPONENT | | SPECIFIC PROCESS |
| | STEEL | 13; | *** STEEL *EAPON | *EAPONG | CANNUNG | | ELECTRODEPOSITION |

| | | | YO SARA | | |
|---|-----------------------|--------------|----------------------------|--|---|
| | EFFORT NO | SERVICE | FUNDING STATUS | TITE | |
| | 6 6119 | A A A | 6 60 | DIMENSIONAL STABILIZATION BY VIBRATORY ENERGY | VIBRATORY ENERGY |
| | | MATERIAL | APPLICATION | COMPGNENT | SPECIFIC PROCESS |
| | STEE | STEEL | SEAPONS SEAPONS | SCAPONG CANNON TUBES | STRESS RELIEF, VIBRATORY |
| | EFFORT NU | SERVICE | YEARS OF FUNDING STATUS | 11116 | |
| | 6 8152 | ARIX | 91 | IMPROVED ANDDE STRAIGHTNESS FOR CHROMIUM PLATING | FOR CHROMIUM PLATING |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | 3TEEL | SZOLVIII. | RAPONS CANNON TUBES | PLATING, CHROMIUM ELECTRODE STRAIGHTNESS |
| : | EFFORT NO | SERVICE | YEARS OF FUNDING STATUS | TITE | |
| | 6 8153 | **** | | INCREASING GUN TUBE HEAT TREATMENT CAPACITY | THENT CAPACITY |
| | | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | OZOAVUE OZOAVUE | CANNON TUBES | HEAT TREATMENT, CONT. |
| | EFFURT NO | SERVICE | YEARS OF FUNDING STATUS | TITLE | |
| | 814212 | AIR FORCE | 7 0 0 A | MT FOR MCCRALY COATING PROCESS SCALEUP | 35 SCALEUP |
| | | HATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | 8 8 8 9 9 | SUPERALLOY | Y AIRCRAFT | TURBINE ENGINES DLADE TURBINE | COATING |

| EFFORT NO SERVICE FUNDING STATUS TITLE BLADE SUPERALLOY AIRCRAFT TURBINE ENGINES BLADE O1H279 AIR FORCE 80 NU HT FOR VACUUM PLASHO SPINATERIAL APPLICATION COMPONENT TURBINE ENGINES BLADES EFFORT NO SERVICE FUNDING STATUS TITLE BLADES BIADES EFFORT NO SERVICE FUNDING STATUS TITLE BLADES TO MATERIAL APPLICATION COMPONENT TITLE BLADES EFFORT NO SERVICE FUNDING STATUS TITLE BLADES TATANIUM AIRCRAFT GOMPONENT FOR BLADES TATANIUM AIRCRAFT RATERIAL APPLICATION COMPONENT FOR BLADES | * | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|--|---|-----------|------------|---------------------|----------|---------|--|--------------------------|
| EFFORT NO SERVICE FUNDING STATUS OIM279 AIR FORCE 80 NU MATERIAL APPLICATION SUPERALLOY AIRCRAFT SUPERALLOY AIRCRAFT MATERIAL APPLICATION SUPERALLOY AIRCRAFT WATERIAL APPLICATION 1 8017 ARMY 75 MATERIAL APPLICATION TITANIUM AIRCRAFT | • | DNA00745 | *> | 7.0 | | ELECTRO | ELECTROPLATED ALUMINIDE COATING | |
| EFFORT NO SERVICE FUNDING STATUS OIM279 AIR FORCE 80 NU SUPERALLOY AIRCRAFT FFORT NO SERVICE FUNDING STATUS BIM213 AIR FORCE 70 MATERIAL APPLICATION SUPERALLOY AIRCRAFT 1 8017 ARMY 75 HATERIAL AIRCRAFT 1 8017 ARMY 75 | | | MATERIAL | ď | LICATION | | COMPONENT | SPECIFIC PROCESS |
| EFFORT NO BERVICE FUNDING STATUS OIM279 AIR FORCE 80 NU BUPERALLOY AIRCRAFT SUPERALLOY AIRCRAFT FORCE 70 MATERIAL APPLICATION SUPERALLOY AIRCRAFT THANIUM AIRCRAFT TITANIUM AIRCRAFT | | | SUPERALLOY | A I A | CRAFT | | TCHBINE ENGINES | COATING |
| EFFORT NO SERVICE FUNDING STATUS 01M279 AIR FORCE 80 NU SUPERALLOY AIRCRAFT YEARS OF FUNDING STATUS 81M213 AIR FORCE 70 MATERIAL APPLICATION SUPERALLOY AIRCRAFT 1 8017 ARMY 75 HATERIAL APPLICATION AIRCRAFT AATERIAL APPLICATION AIRCRAFT AATERIAL ABPLICATION AIRCRAFT | ! | | | 1 | • | | BLADE | ELECTRUPLATE, ALUMINIDE, |
| HATERIAL APPLICATION SUPERALLOY AIRCRAFT YEARS OF FUNDING STATUS BIM213 AIR FORCE 78 MATERIAL APPLICATION SUPERALLOY AIRCRAFT 1 8017 ARMY 75 HATERIAL APPLICATION AIRCRAFT AMTERIAL APPLICATION AIRCRAFT | | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| SUPERALLOY AIRCRAFT FFORT NO SERVICE FUNDING STATUS BIM219 AIR FORCE 78 MATERIAL APPLICATION SUPERALLOY AIRCRAFT 1 8017 ARMY 75 HATERIAL APPLICATION 1 8017 ARMY 75 | | 01M274 | AIR FORCE | 0 N 80 60 |) Z | FOR TOR | MT FOR VACUUM PLASMO SPRAY OVERLAY COATINGS | Y COATINGS |
| EFFORT NO SERVICE FUNDING STATUS BIM213 AIR FORCE 70 MATERIAL APPLICATION SUPERALLOY AIRCRAFT 1 8017 ARMY 75 MATERIAL APPLICATION 1 8017 ARMY 75 MATERIAL APPLICATION AIRCRAFT | | | MATERIAL | AP | LICATION | | COMPONENT | SPECIFIC PROCESS |
| FFORT NO SERVICE FUNDING STATUS BIM219 AIR FORCE 70 MATERIAL APPLICATION SUPERALLOY AIRCRAFT 1 8017 ARMY 75 MATERIAL APPLICATION TITANIUM AIRCRAFT | | | SUPERALLOY | | • | | | |
| BIMZIS AIR FORCE 70 MATERIAL APPLICATION SUPERALLOY AIRCRAFT 1 BOLT ARMY 75 MATERIAL APPLICATION 1 BOLT ARMY 75 TITANIUM AIRCRAFT | ; | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| SUPERALLOY AIRCRAFT SUPERALLOY AIRCRAFT VEARS OF FFORT NO SERVICE FUNDING STATUS 1 8017 ARMY 75 MATERIAL APPLICATION TITANIUM AIRCRAFT | • | 81M214 | AIR FORCE | 70 | | | WELD REPAIR SCALE UP | |
| SUPERALLOY AIRCRAFT YEARS OF YEARS | ; | | MATERIAL | 44 | LICATION | | COMPONENT | SPECIFIC PROCESS |
| VEARS OF EFFORT NO SERVICE FUNDING STATUS 1 8017 ARMY 75 MATERIAL APPLICATION TITANIUM AIRCRAFT | | | SUPERALLOY | AIA | CRAFT | • | CLACE NE ENGINE GENERAL SELECTION OF THE | CLEANING, FLUDRIDE ION |
| 1 8017 ARMY 75 MATERIAL APPLICATION TITANIUM AIRCRAFT | 3 | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | | | |
| MATERIAL APPLICATION COMPONENT TITANIUM AIRCRAFT ROTOR BLADE | | 1 6017 | ARMY | 75 | | LEADING | LEADING EDGE PROTECTIVE STRIP FOR | MAIN ROTOR BLADES |
| TITANIUM AIRCRAFT ROTOR BLADE | 3 | | MATERIAL | APA | LICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | | AIA | CRAFT | | ROTOR BLADE LEADING EDGE STRIP | COATING |

A THE COURSE WANTED TO SEE THE COURSE OF THE

SURFACE TREATHENT

| EFFORT NO S | SFRVICE AIR FORCE | FUNDING STATUS TITLE | TITLE MT FOR ALUMINIDE-PRODUCTION-COATING-PROCESS-SCALE-UP | PROCESSASCALE-UP |
|-------------|----------------------|----------------------|---|------------------|
| | MATERIAL | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | TI-ALUMINIDE | DE AIRCRAFT | SUNCES AND SUNCES | |

SUBCOMMITTEE ACCOMPLISHMENTS

INITIATED PLANS FOR DOD/INDUSTRY WORKSHOP ON PROTECTIVE COATINGS

FUTURE SUBCOMMITTEE ACTIVITIES

- INVESTIGATE THE POSSIBILITY OF A JOINT ARMY/AIR FORCE PROGRAM FOR HIGH TEMPERATURE TURBINE **ENGINE SEALS**
- SPONSOR TWO DOD/INDUSTRY WORKSHOPS ON PROTECTIVE COATINGS

THE SUBCOMMITIEE INITIATED PLANS FOR A DOD/INDUSTRY WORKSHOP ON PROTECTIVE COATINGS.

WERE ESTABLISHED, THE SUBCOMMITTEE HAS DECIDED TO BREAK THE PROTECTIVE COATINGS THE ARMY AND AIR FORCE WILL INVESTIGATE THE POSSIBILITY OF JOINTLY FUNDING AN EFFORT ON HIGH TEMPERATURE TURBINE ENGINE SEALS. BASED UPON THE PLANS THAT AREA INTO TWO PARTS AND HOLD TWO DOD/INDUSTRY WORKSHOPS. A STATUS OF OUR EFFORTS ARE GIVEN IN THE NEXT CHART.

PROTECTIVE COATINGS WORKSHOP

STATUS

INITIAL GOVERNMENT WORKSHOP HELD

● 9-11 OCT 1979

NASA LEWIS RESEARCH CENTER

REPRESENATIVES FROM

ARMY NAVY AIR FORCE NASA DOE

FUTURE DOD/INDUSTRY MEETING

HAS ATTRACTED A GREAT DEAL OF INTEREST AS A POTENTIAL MEANS OF ECONOMICALLY APPLYING UNDERWAY WITHIN THE GOVERNMEN!. TO THIS END, AN INITIAL GOVERNMENT WORKSHOP WAS HELD ON 9 TO 11 OCTOBER AT THE NASA LEWIS RESEARCH CENTER. REPRESENTATIVES FROM THE AD-HOC PLANNING GROUP DECIDED THAT THEIR APPROACH TO PLANNING FOR A DOD/ SURFACED IS THE PROCESS USED TO APPLY THESE COATINGS. FOR EXAMPLE, PLASMA SPRAY ARMY, NAVY, AIR FORCE, NASA AND DOE DISCUSSED COATING PROJECTS BEING PURSUED IN THEIR RESPECTIVE ORGANIZATIONS. MANY SIMILARITIES WERE FOUND. FOR EXAMPLE, IN INDUSTRY MEETING SHOULD BEGIN WITH AN EFFORT TO DETERMINE WHAT WORK WAS ALREADY HE TURBINE AREA, COATINGS ARE BEING DEVELOPED TO SOLVE PROBLEMS FOR DIFFERENT OPERATING CONDITIONS ENCOUNTERED BY EACH SERVICE. BUT THE COMMONALITY WHICH THESE COATINGS.

FIRST MEETING WILL MOST LIKELY CONCERN PROPULSION SYSIEMS. THE SECOND MEETING WILL PRESENTED AT THE OCTOBER MEETING. WHEN THIS IS COMPLETED THEY WILL TURN THEIR ATTENTION TO PLANNING WHAT NOW APPEARS TO BE TWO DOD/INDUSTRY MEETINGS. THE THE AD-HOC PLANNING GROUP IS NOW ANALYZING AND CONSOLIDATING THE DATA MOST LIKELY BE HELD IN THE FALL AND WILL DEAL WITH ALL OTHER COATINGS.

FORMING

■ 25-29 MILLION

FIVE YEAR FORECAST

| <u></u> | 81-85 | 13% | 20 |
|-----------------|--------------|--------------------------|-------------|
| <u>6</u> | 80-84 | 15% | 80 |
| 72.//// | 79-83 | * | 79 |
| 6 | 78-82 | 6 % | 78 |
| | FISCAL YEARS | PROGRAMS | FISCAL YEAR |
| ANS | | YEAR | |
| FIVE YEAR PLANS | | INDIVIDUAL YEAR PROGRAMS | |
| | | | |
| COMPARISON OF | | COMPARISON OF | |

LEVEL OF EFFORT. THE COMPARISON OF INDIVIDUAL YEAR PROGRAMS SHOWS THAT EXPENDI-TURES HAVE RISEN IN THE PAST TWO YEARS TO THE LEVELS PREDICTED BY THE FIVE YEAR IN THE FORMING AREA, THE FIVE YEAR FUNDING FORECAST PROJECTS AN EXPENDITURE OF BETWEEN 25-29 MILLION. THE COMPARISON OF FIVE YEAR PLANS SHOWS A CONSTANI PLANS.

TECHNICAL OBJECTIVES

- INCREASE COMPLEX SHAPE CAPABILITY
- REDUCE NUMBER OF FORMING STEPS
- **DELIMINATE SECONDARY OPERATIONS**

THE TECHNICAL OBJECTIVES BEING SOUGHT IN THE FORMING AREA ARE TO INCREASE COMPLEX SHAPE CAPABILITY, REDUCE THE NUMBER OF FORMING STEPS AND TO ELIMINATE SECONDARY OPERATIONS.

FREQUENCY SPECIFIC PROCESS

COLLING
COLD FORMING
LECTROFORMING
ELECTRO-MAGNETIC
FORMING, CREEP
HEAVY DUTY LEVELING
HEAVY DUTY LEVELING
HEAVY DUTY
STRETCHING
HEAVY DUTY
STRAIGHTENING
STRESS CONTROL
PRESS STRAIGHTENING
SHEAR SPINNING
SPE/DB
STRAIGHTEN BLADES
STRAIGHTEN BLADES
STRAIGHTEN BLADES
SUPERPLASTIC FORMING

ULTRASONIC FORMING

and the state of

THE SPECIFIC FORMING PROCESSES AND THE NUMBER OF PROJECTS ASSOCIATED WITH EACH PROCESS IS SHOWN ON THIS CHART.

FY81 PROGRAM REVIEW

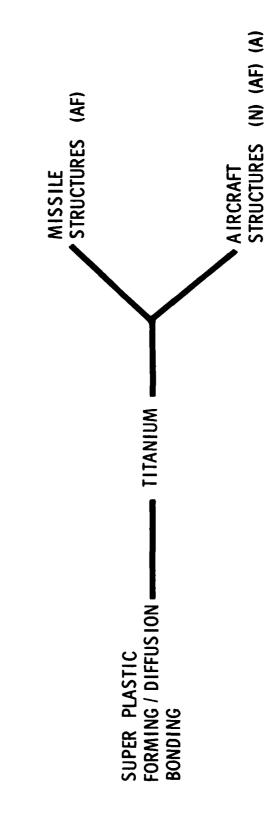
- 14 PROJECTS REVIEWED
- COMMON AREAS IDENTIFIED
- SUPER PLASTIC FORMING/DIFFUSION BONDING

THE SUBCOMMITTEE REVIEWED 14 FY81 PROJECTS. SUPERPLASTIC FORMING/DIFFUSION BONDING WAS THE ONLY COMMON AREA IDENIFIED.

APPLICATION

MATERIAL

PROCESS



ALL THREE SERVICES ARE DOING WORK IN SUPERPLASTIC FORMING/DIFFUSION BONDING. THE NAVY AND ARMY ARE APPLYING THE RESULTS OF PRIOR AND ON-GOING WORK SPONSORED BY THE AIR FORCE. THE SUBCOMMITTEE FOUND NO DUPLICATION OF EFFORT,

FY80 PROGRAM CHANGES REVIEW

D 5 NEW PROJECTS REVIEWED

COMMON AREAS IDENTIFIED

NO NEW AREAS

THE FOLLOWING COMPUTER PRINTOUT LISTS ALL ACTIVE, APPORTIONMENT AND BUDGET PROJECTS THE SUBCOMMITTEE REVIEWED 5 NEW FY80 PROJECTS AND IDENTIFIED NO NEW COMMON AREAS. THAT HAVE BEEN CLASSIFIED AS FORMING. THE PROJECTS HAVE BEEN SORTED BY THE MATERIAL BEING FORMED AND THE APPLICATION.

| * | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
|---------------|--|-----------|-----------------------|-------------|--------|--|-----------------|--|
| * | 1043 | AIR FORCE | 00 | | MT FOR | MANUFACTURING COST/DESIGN GUIDE | ST/DESIGN BUIL | 96 |
| : | | MATERIAL | API | APPLICATION | | COMPONENT | 148 | SPECIFIC PROCESS |
| | ALUMIA | ALUMINUM | AI | AIRCRAFT | | CA ALRCRAFT ALREAGES | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | C810 | AIR FURCE | 80 | | MT FOR | MT FOR SHEET METAL CELL DEMONSTRATIONS | . DEMONSTRATION | 0 Z |
| • | | MATERIAL | 144 | APPLICATION | | COMPONENT | 96 | SPECIFIC PROCESS |
| | ALUMIN | ALUMINUM | UH AIRCRAFT AIRFRAMES | AIRCRAFT | | AIRFRAMES | | |
| | | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| * * * * | 010800 | AIR FORCE | 98 | | MT FUR | | TAL MACHINE DI | OPTIMAL SHEET METAL MACHINE DESIGNS AND TRANSITION |
| ; | | MATERIAL | API | APPLICATION | | COMPONENT | 46 | SPECIFIC PROCESS |
| | VINCIPLE TO THE PROPERTY OF TH | ALUMINUM | 1 | AIRCRAFT | | AIRCRAFT AIRFRAMES | | |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | 010805 | AIR FORCE | 0 80 | | MT FOR | MT FOR OPTIMAL SHEET METAL CENTER DESIGN | TAL CENTER DES | 2310 |
| | | MATERIAL | AP | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | | ALUMINUM | JI V | AIRCRAFT | | ALUMINUM AIRCRAFT AIRFRAMES | | |

| | . | SPECIFIC PROCESS | | | A 6 1 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 6 1 | SPECIFIC PROCESS | | | | SPECIFIC PROCESS | SAMPACO | 3450134 | | 1ACHINE | SPECIFIC PROCESS | STRAIGHTEN BLADES |
|------------------|----------------------------------|------------------|---|---------------------|---|------------------|---------------------|---------------------|------------------------------|------------------|-------------------|--------------------------------------|------------------|---------------------------------------|------------------|-------------------|
| | MT FOR UNIFIED SMEET METAL MODEL | CCMPONENT | AIRFRAKES | | MT FOR LOW COST ZOMM CARTRIDE CASES | COMPONENT | ZOMM CARTRIDGE CASE | | DIMPLE PLATE WEB FOR BRIDGES | COMPONENT | BRIDGE | STRUCTURAL MEMBERS | | PROPELLOR BLADE STRAIGHTENING MACHINE | COMPONENT | PROPELLORS |
| TITLE | MT FOR | | | TITLE | MT FOR | | | TITLE | DIMPLE | | MENT | | TITLE | PRUPELL | | |
| STATUS | | APPLICATION | AIRCRAFT | STATUS | 2 | APPLICATION | | | | APPLICATION | SUPPORT EQUIPMENT | | STATUS | | APPLICATIUN | SHIPS |
| YEARS OF FUNDING | 0 | API | AIRCRANT | YEARS OF FUNDING | 90 | Ā | AMMUNITION | YEARS OF FUNDING | 79 | API | ins | 1 0 0 0 0 0 0 0 | YEAMS OF FUNDING | 81 | API | T. S |
| SERVICE | AIR FORCE | MATERIAL | ALUMINUM | SERVICE | AIR FORCE | MATERIAL | ALUMINUM | SERVICE | ARAY | MATERIAL | ALUMINUM | | SERVICE | % × × × | MATERIAL | BRONZE |
| EFFORT NO | 910701 | | 000000000000000000000000000000000000000 | EFFORT NO | 98m126 | | | EFFGRT NO | E 3761 | | | | EFFORT NO | DNS00641 | | |
| | * | | | • | • | ; | | ; | # # | ; | k k | | ; | k K | ; | |

| AIRFRANES TITLE COMPONENT ZOMM CARTRIDGE CASE DIMPLE PLATE WEB FOR BRIDGES COMPONENT TITLE STRUCTURAL MEMBERS STRUCTURAL MEMBERS TITLE PROPELLOR BLADE STRAIGHTENING MACH COMPONENT PROPELLOR BLADE STRAIGHTENING MACH | * * | EFFORT NO 91C701 | SERVICE AIR FORCE | 8 0 E C C C C C C C C C C C C C C C C C C | 80 TA A C | TITLE MT FOR | TITLE mt for unified sheet metal model component | MODEL SPECIFIC PROCESS |
|--|--------|---------------------------------|----------------------|---|------------|-----------------|--|---------------------------|
| EFFORT NO SERVICE FUNDING STATUS TITLE 98MI26 AIR FORCE 80 NU MT FOR LOM COST 20MM CARTRIDE CASE ALUMINUM AMMUNITION ZOMM CARTRIDGE CASE EFFORT NO SERVICE FUNDING STATUS TITLE EFFORT NO SERVICE FUNDING STATUS TITLE ALUMINUM SUPPORT EQUIPMENT BRIDGE STRUCTURAL MEMBERS STRUCTURAL MEMBERS ONSOO641 NAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BRONZE SHIPS PROPELLOWS BRONZE SHIPS | * * | | ' | RIA | CRAFT | | S S S S S S S S S S S S S S S S S S S | |
| MATERIAL APPLICATION COMPONENT SET OF ELDMINOUM ANNUNTION COMPONENT SET OF FUNDING STATUS TITLE E 3761 ARMY 79 DIMPLE PLATE WEB FOR BRIDGES ALUMINUM SUPPORT EQUIPMENT BRIDGE STRUCTURAL MEMBERS FUNDING STATUS TITLE STRUCTURAL MEMBERS FUNDING STATUS TITLE DNS00641 NAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BRODZE SHIPS PROPELLORS PROPELLOWS BRODZE SHIPS PROPELLOWS PROPERTY NO. COMPONENT PROPELLOWS PROPERTY NO. COMPONENT PROPERTY NO. COMP | | EPFORT NO | ER VICE | YEARS OF FUNDING | STATUS | TITLE | ļ | |
| EFORT NO SERVICE FUNDING STATUS TITLE E 3761 ARMY 79 DIMPLE PLATE WEB FOR BRIDGES EFFORT NO SERVICE FUNDING STATUS TITLE ALUMINUM SUPPORT EQUIPMENT BRIDGE STRUCTURAL MEMBERS FFORT NU SERVICE FUNDING STATUS TITLE DNS00641 NAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BRDNZE SHIPS PROPELLOWS | # | 98H126 | AIR FORCE | 790 | 2 | MT FOR | LOW COST ZOMM CARTR | NOE CASES |
| EFFORT NO SERVICE FUNDING STATUS TITLE EFFORT NO SERVICE FUNDING STATUS TITLE ALUMINUM SUPPORT EQUIPMENT BRIDGE STRUCTURAL MEMBERS VEARS OF EFFORT NO SERVICE FUNDING STATUS TITLE DNSOO641 NAVY B1 PROPELLORS BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT MATERIAL APPLICATION COMPONENT BRONZE SHIPS PROPELLORS PROPERT PROPELLORS PROPERT PROPELLORS PROPERT PROPELLORS PROPERT | | | MATERIAL | 9 V | LICATION | | COMPONENT | SPECIFIC PROCESS |
| FFORT NO SERVICE FUNDING STATUS TITLE E 3761 ARMY 79 DIMPLE PLATE WEB FOR BRIDGES ALUMINUM SUPPORT EQUIPMENT BRIDGE YEARS OF FFORT NO SERVICE FUNDING STATUS TITLE DNS00641 NAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BRDNZE SHIPS PROPELLOWS | # | 2 1 1 1 0 0 0 | AUNIE III | ANA | JUNITION | | | |
| E 3761 ARMY 79 DIMPLE PLATE WEB FOR BRIDGES ALUMINUM SUPPORT EQUIPMENT BRIDGE STRUCTURAL MEMBERS VEANS OF FINDING STATUS TITLE DNSO0641 NAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BRDNZE SHIPS PROPELLOWS | | EFF GRT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | - | |
| ALUMINUM SUPPORT EQUIPMENT BRIDGE ALUMINUM SUPPORT EQUIPMENT BRIDGE STRUCTURAL MEMBERS VEXHOR OF | * | E 3761 | A W | 79 | | DIMPLE | PLATE WEB FOR BRIDG | න 13 |
| ALUMINUM SUPPORT EQUIPMENT BRIDGE STRUCTURAL MEMBERS YEARS OF YEARS OF STATUS TITLE DASO0641 MAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BROWZE SHIPS PROPELLOWS | | | MATERIAL | Αρί | PLICATION | | COMPONENT | SPECIFIC PROCESS |
| STRUCTURAL MEMBERS YEARS OF FEFORT NO SERVICE FUNDING STATUS TITLE DNSOO641 NAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BRONZE SHIPS | æ Æ | | ALUMINUM | ins | PPORT EQUI | PMENT | BRIDGE | CALCINE FOR |
| YEAH! OF STATUS TITLE DASO0641 NAVY 81 PROPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BROWZE SHIPS | | | | 0 0 0 0 0 0 1 | , | | STRUCTURAL MEMBERS | |
| DASOO641 NAVY 81 PRUPELLOR BLADE STRAIGHTENING MACH MATERIAL APPLICATION COMPONENT BROWZE SHIPS PROPELLOWS | |) ì | | YEARS OF FUNDING | STATUS | TITLE | . , , | |
| MATERIAL APPLICATION COMPONENT BROWZE SHIPS PROPELLOWS | # # | | AAV | 9.1 | | PROPELI | LOR BLADE STRAIGHTE! | NING MACHINE |
| BRONZE STIPS STIPS 37NORB | | | MATERIAL | d∀ | PLICATIUN | | COMPONENT | SPECIFIC PROCESS |
| | * | | BRONZE | IS : | Sel | | PROPELLOWS | STRAIGHTEN BLADES |

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
|-----------------------|---------------------------------------|-----------------------|---|-------------|------------------|--|----------|--|
| • | 014219 | AIR FORCE | 80 80 0 1 | | FOR | STATIC ALUMINIDE COMPONENTS PROCESSING | COMPONEN | TS PROCESSING |
| | | MATERIAL | d d v | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | | 01HER | AIRCRAFT | AIRCRAFT | | TURBINE ENGINES BLADES TURBINE | | |
| | EFF URT NO | , tal | YEARS OF FUNDING | STATUS | TITLE | | | |
| * * * * * * * * | 5 6634 | A M Y | 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | | ⊙ 9 ¥ ¥ | ALLOYS FOR LARGE | CALIBER | MFG DU ALLOYS FOR LARGE CALIBER ARMOR DEFEATING PROJECTYLE |
| | | MATERIAL | 4 | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| * * * * * | | OTHER | I I | AMMUNITION | | METAL PARTS | | CASTING ROLLING |
| ! | | 0 0 0 0 0 | • | | | PROJECTILES | | AACI I NA |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| : . | DN800564 | × × × | 10 | | HEAT E | HEAT EXCHANGER FABRICATION | NOI | |
| : | | MATERIAL | 4 d 4 | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | • • • • • • • • • • • • • • • • • • • | STEEL | X 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | AMMUNITION | | HEAT EXCHANGER, | TORPEDO | ELECTROFORMING |
| • | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | DN800547 | NAVY | 81 | | HARHEAD | O COMPONENT FABRICATION | CATION | |
| ; | | MATERIAL | 16 V | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | | | * | AMMUNITION | | WARHEAD, TOMPEDO | | HYDRUFGRHING |
| | | • | | | | | | |

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
|-----|---|---|---------------------|---------------|------------------|---|--------------------------|---|
| | 5 1001 | A E | 90 90 | | PILOT | PILOT LINE FOR FUZE FLUIDIC POWER SUPPLIES | LUIDIC POWER | STAGENTS |
| ; | | MATERIAL | 4 | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | 8 6 8 8 8 8 8 | 875EL | 至 | AMECNITION | | FUZES | | PROGRESSIVE DIE FORMING Assembly |
| | EFFORT NO | SFRVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | 5068 | A A A | O 60 | | Z Z | NEW ANTI-CORROGIVE MA | MATERIALS AND TECHNIQUES | ECHNIQUES |
| | | MATERIAL | A P F | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 의 변 명 명 | | LAND VEHICLES | 0 0 0 0 | SHEET METAL CO | COMPONENTS | DIE FORMING Spot Welding |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| * * | T 6023 | A & & & & & & & & & & & & & & & & & & & | 7.8 | | FABRIC | FABRICATION OF FLAT THIN GAGE ALLOY STEEL PLATE | THIN GAGE ALLC | IY STEEL PLATE |
| | | MATERIAL | A | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | | STEEL | LA | LAND VEHICLES | 8 1 1 | LAND VEHICLES ARMOR | | HEAVY DUTY LEVELING HEAVY DUTY DIE PRESSING HEAVY DUTY STRETCHING |
| ; | EFFORT AU | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | |
| | H 3294 | A T T | 80 80 11 | | PRODUC | PRODUCTION PROCESSES FOR ROTARY ROLL FORMING | FOR RUTARY RC | ILL FORMING |
| | | MATERIAL | ¥ d ¥ | APPLICATION | | COMPONENT | | SPECIFIC PROCESS |
| | *************************************** | STEFL | NI E | MISSILES | | AISSILES ROCKET MOTOR | | ROTARY ROLL FORMING |

| : : | EFFORT NO | SERVICE | YEARS OF FUNDING | SULATE | TITLE | |
|--------|-----------|----------|---|-------------|--|--|
| * * | 017006NO | ** | 79 | | MAGNETIC FORMING OF BOILER TUBES | |
| | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | | | SCHIOS SCHOOL SC | ELECTRO-MAGNETIC |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| * * | DNS00572 | 7 A Z | 81 | | ADJUSTABLE POST MOCK SYSTEM | |
| | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | X 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 5 | MULL STRUCTURE | |
| | EFFURT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| * | 6 3901 | ARMY | 780 | | MANUFACTURE OF FLUIDIC AMPLIFIERS BY COLD FORMING | B BY COLD FORMING |
| | | MATERIAL | 4 | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | STEEL | AEAPONG | GUN STABILIZATION SYSTEM FLUIDIC CONTROL SYSTEMS | COLD FORMING |
| , | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| * | 6 7087 | A # # # | 7.3 | | APPLICATION OF HIGH FREQUENCY IND | APPLICATION OF HIGH FREQUENCY INDUCTION HEATING FOR HOT COIL SPRINGS |
| ; | | MATERIAL | € | APPLICATION | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | 3 | WEAPONS | LARGE CALIBER | SUPPORTION REATING |
| | | | | | RECOIL GPRINGS | 201211 221410 |

| | EFFORT NO | SERVICE | YEARS OF FUNDING ST | STATUS | TITLE | | |
|---------------|-----------|----------------|---|-----------------|---------|---|--------------------------------------|
| * | 6 7720 | ARMY | 11 | | FABRICA | FABRICATION METHODS FOR 2 AND 3 WIRE MECHANICAL SPRINGS | WIRE MECHANICAL SPRINGS |
| | | MATERIAL | APPLICATION | ATION | | COMPONENT | SPECIFIC PROCESS |
| | | STEEL | 8 | 9 | | GAALL CALIBER OPRINGS | 5%ITI%5 |
| | EFFORT NO | <u>u</u> | YEARS OF FUNDING ST | STATUS | TITLE | | |
| * * | 5 8045 | ARMY | 7.8 | | IMPROVE | IMPROVED TUBE STRAIGHTENING | |
| | | MATERIAL | APPLICATION | ATION | | COMPONENT | SPECIFIC PROCESS |
| * | | STEEL STEEL | x | | | CANNON TUBES | PARGO GTAAIGHTRNING Pargo Control |
| | EFFORT NO | SERVICE | YEARS OF FUNDING STA | 2 | 9 TITLE | ul J | |
| * | 11 4201 | AIR FORCE | 8 8 8 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | | MT FOR | EXPLOSIVE FABRICATION OF | ENGINE COMPONENTS |
| ; | | MATERIAL | APPLICATION | ATION | | COMPONENT | SPECIFIC PROCESS |
| | | SUPERALLOY | AIRCRAFT | - - - | | TURBINE ENGINES SHROUDS SHROUDS EXPLOSIVE FORMING | |
| ; | EFFORT NO | SERVICE | YEARG OF FUNDING ST | STATUS | TITLE | | |
| # # # # | DNA61026 | × × × | 7.0 | | SPF/08 | OF TITANIUM GLOVE VANE | |
| : | | MATERIAL | APPLICATION | ATION | | COMPONENT | SPECIFIC PROCESS |
| | | TITANIUM | AIRCRAFT | L | | AIRFRAME Structural members | 8PF/08 |

| # # # | | | | | | | | |
|---------------|-----------|----------------|--|---------------------|-------------|---------|---|--|
| | EFFORT NO | 3 | SERVICE | FUNDING | STATUS | TITLE | | |
| 4 4 4 4 | 01 4242 | | AIR FORCE | 90 | 2 | MT FOR | APPLICATION OF | SPF/DS TITANIUM FABRICATION |
| : | | | MATERIAL | AP | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | TO THE STATE OF TH | 1 | AIRCRAFT | : | OPF/DB T38 MAIN LANDING GEAR | |
| ; | EFFORT NO | O _N | | YEARS OF FUNDING | STATUS | TITLE | | |
| * * | 114220 | | AIR PORCE | | | TITANIL | TITANIUM COMPONENTS FOR BERVICE EVALUATION | EVALUATION |
| ; | | | MATERIAL | Īď | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | MUINATIT | IV | AIRCRAFT | | TSB MORIZ STABILIZER | 801/08 |
| | EFFORT NO | <u>2</u> | SERVICE | YEARS OF Funding | STATUS | TITLE | | |
| * | 1 7284 | | A R M × | 78 | | SUPERPL | SUPERPLASTIC FORMING - DIFFUSION GONDING OF TITANIUM | BONDING OF TITANIUM |
| • | | | MATERIAL | 4 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | TITANIUM | AIRCRAFT | AIRCRAFT | | 1 | BUPERPLABILC FORMING BONDING, DIFFUSION |
| , | EFFORT NO | 0 | SFRVICE | YEARG OF FUNDING | STATUS | TITLE | | |
| * | 1 7652 | | A A A | 80 77 | | ULTRASC | ULTRASONICALLY-ASSISTED COLD FURMING OF TITANIUM NOSE | HING OF TITANIUM NOSE CAPS |
| | | | MATERIAL | d | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | TITANIUM | I | AIRCRAFT | | RUTUR BLADES NOSE CAPS | ULTRABONIC FORMING |

| : | EFFORT NO | Q | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
|----------|-------------|---|-----------|---------------------|-----------------------|--------|---|--|
| | 51H875 | | ATR FORCE | 75 57 | | MT FOR | LOW COST NONROTATING | LOW COST NONROTATING TITANIUM ENGINE COMPONENTS |
| | | | MATERIAL | Ĭ. | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| ! | | | TITANIUM | IV | AIRCRAFT | | TURBLINE REGIENS | PORMING, CREEP |
| į | | į | | | 8 8 8 8 8 | | COMPRESSOR CASES | BONDING, DIFFUBION |
| | EFFORT NO | o | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| <u>.</u> | 714163 | | AIR FORCE | 76 | 2 | MT FOR | MT FOR APPLICATION OF SPP/OB TITANIUM FABRICATION | HITANICK PABRICATION |
| : | | | MATERIAL | İdv | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | 717AN T17AN | | TITANIUM | A 2 1 | AIRCRAFT | | AIRCRAFT DOOR STRUT MLG | 807408 |
| • | EFFORT NO | 0 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| • | 714862 | | AIR FORCE | 70 | | MT FOR | SPF/DB LIMITS OF THE | SPF/OS LIMITS OF THE MANUFACTURING PROCESS |
| | | | MATERIAL | 144 | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | į | TITANICA | AIA AIA | AIRCRAFT | • | TITANIUM AIRCRAFT AIRFRAME STRUCTURES | 807708 |
| | EFFORT NO | 0 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | 01 H 1 1 0 | | AIR FORCE | 70 | 3 | F OF | MANUFACTURING SCALETU | MANUFACTURING SCALE-UP OF COLD FORMABLE TI SMEET |
| * | | | MATERIAL | AYA | APPLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | TITANIUM | AIA | AIRCRAFT | | SULVATION FRANCISIA SULVATION | |

| AIR FORCE MATERIAL TITANIUM AIRCRAFT AIRCRAFT AIRCRAFT AIRCRAFT AIRCRAFT AIRCRAFT TITANIUM AIRCRAFT AIRCR | R # | EFFORT NO | Q | SERVICE | YEARS OF FUNDING | STATUS | 7176 | | |
|--|--------|-----------|---|-----------|---------------------|-----------|---------|---|-------------------|
| EFFORT NO SERVICE FUNDING STATUS BINZS6 AIR FORCE 78 MATERIAL APPLICATION TITANIUM AIRCRAFT MATERIAL APPLICATION TITANIUM AIRCRAFT MATERIAL APPLICATION MATERIAL APPLICATION TITANIUM MAVY TO DUSOUGH MAY AND MISSILES | :. | 81 M255 | ! | AIR FORCE | 7.0 | | ~ | APPLICATION OF 8PP/08 TITAMIUM FABRICATION | ANIUM FABRICATION |
| EFFORT NO SERVICE FUNDING STATUS 01M256 AIR FORCE TO APPLICATION TITANIUM AIRCRAFT VEARS OF STATUS 91M204 AIR FORCE BO DISCRAFT TITANIUM AIRCRAFT EFFORT NO SERVICE FUNDING STATUS DNS00044 NAVY TITANIUM AIRCRAFT FORD NAVY TITANIUM MISSILES | | | | MATERIAL | d | PLICATION | | COMPONENT | SPECIFIC PROCESS |
| EFFORT NO SERVICE FUNDING STATUS 61M256 AIR FORCE 70 MATERIAL APPLICATION TITANIUM AIRCRAFT FFORT NO SERVICE 80 79 81 MATERIAL APPLICATION TITANIUM AIRCRAFT TITANIUM AIRCRAFT FFORT NO SERVICE FUNDING STATUS ONSO0644 NAVY TITANIUM MISSILES | | | | | | RCRAFT | | AINFRAME STRUCTURES | 60/448 |
| FFORT NO SERVICE FUNDING STATUS PIMAGO AIR FORCE BO TITANIUM AIRCRAFT TITANIUM AIRCRAFT TITANIUM AIRCRAFT TITANIUM AIRCRAFT TITANIUM AIRCRAFT TITANIUM AIRCRAFT TITANIUM AIRSSILES DNSOO644 NAVY TO MISSILES | : | EFFORT | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| EFFORT NO SERVICE FUNDING STATUS 91M204 AIR FORCE 80 79 79 81 TITANIUM AIRCRAFT TITANIUM AIRCRAFT TO SERVICE FUNDING STATUS ONSO0644 NAVY TITANIUM MISSILES | | 81M256 | | AIR FORCE | 7.0 | | MT FOR | MI FOR MULTIPLE SMEET ASSEMBLY BY SPF/DB | V 3PF/DB |
| EFFORT NO SERVICE FUNDING STATUS 91M204 AIR FORCE 80 79 81 MATERIAL APPLICATION TITANIUM AIRCRAFT TITANIUM AIRCRAFT TOUS SERVICE FUNDING STATUS DNS00644 NAVY TOUS MATERIAL APPLICATION MISSILES | | | | MATERIAL | V | PLICATION | | COMPONENT | SPECIFIC PROCESS |
| FFORT NO SERVICE FUNDING STATUS 91M204 AIR FORCE 80 61 MATERIAL APPLICATION TITANIUM AIRCRAFT FFORT NO SERVICE FUNDING STATUS DNS00644 NAVY THANIUM MISSILES | | | | TITANIUM | A 11 | RCRAFT | | AIRFRAME STRUCTURES Horizontal tail surfaces | 861/08 |
| PIMEGA AIR FORCE BO TITANIUM AIRCRAFT TITANIUM AIRCRAFT VEARS OF EFFORT NO SERVICE FUNDING STATUS DNSO0644 NAVY THANIUM MISSILES | | EFFORT | 9 | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| TITANIUM AIRCRAFT TITANIUM AIRCRAFT YEARS OF FUNDING STATUS DNS00644 NAVY 79 MATERIAL APPLICATION TITANIUM MISSILES | | 91 #204 | | AIR FORCE | 949 | | FOR FOR | INNOVATIVE LOM COST TOOLING | 9 2 |
| EFFORT NO SERVICE FUNDING STATUS ONSOOB44 NAVY AMTERIAL APPLICATION TITANIUM MISSILES | | | | MATERIAL | 4 | PLICATION | | COMPONENT | SPECIFIC PROCESS |
| FFORT NO SERVICE FUNDING STATUS ONSOOB44 NAVY HATERIAL APPLICATION TITANIUM MISSILES | • | | | TITANIUM | A 11 | RCRAFT | | ALREADIC ENCHANGE | 867/08 |
| DNSOO644 NAVY 70 MATERIAL APPLICATION TITANIUM MISSILES | | | Q | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | |
| | | | 7 | NAVY | * | | ISOTHEF | ISOTHERMAL FORMING OF TRANSAGE TITANIUM | ITANIUM |
| | | | | MATERIAL | Ā | PLICATION | | COMPONENT | SPECIFIC PROCESS |
| | | | | | X | SSILES | | PACOSCAE VEGGE | BILLING BEINGING |

| MATERIAL APPLICATION COMPONENT SPECIFIC PROCESS TITANIUM MISSILES TANK, PROPELLANT SPECIFIC PROCESS |
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| ٠ |
| |

FUTURE SUBCOMMITTEE ACTIVITY

INVESTIGATE POSSIBILITY OF JOINT NAVY/AIR FORCE PROGRAM TO DEFINE THE LIMITS OF SUPER PLASTIC FORMING/DIFFUSION BONDING

OF JOINING THE AIR FORCE IN THEIR PROGRAM TO DEFINE THE LIMITS OF SUPERPLASTIC DURING THE PROJECT REVIEW, THE NAVY EXPRESSED INTEREST IN THE POSSIBILITY FORMING/DIFFUSION BONDING.

OTHER

FREQUENCY SPECIFIC PROCESS

- HOT ISOSTATIC PRESSING
- HOT PRESSING
- LOOSENING FASTENERS
 - MATERIAL HANDLING PRESSURE TESTING
- RARE EARTH ADDITIONS
 - REACTION BONDING REMANUFACTURE SINTERING SLIP CASTING

265

THE NUMBER OF PROJECTS DEALING WITH EACH PROCESS IS ALSO SHOWN. THESE PROCESSES PRIMARILY FALL INTO THE CATEGORIES OF CERAMIC PROCESSING AND SPECIFIC PROCESSES THE "OTHER PROCESSES" AREA CONSISTS OF THE SPECIFIC PROCESSES SHOWN HERE. FOR REPAIR.

OTHER METAL PROCESSES

FY 81 PROGRAM REVIEW

A PROJECTS REVIEWED

COMMON AREAS IDENTIFIED

HOT PRESSING

THE SUBCOMMITTEE REVIEWED 4 FY81 PROJECTS AND IDENTIFIED HOT PRESSING AS

A COMMON AREA.

OTHER METAL PROCESSES

APPLICATION TURBINE ENGINE COMPONENTS (A) (AF) ADIABATIC DEISEL (A) MATERIAL CERAMICS HOT PRESS ING **PROCESS**

WHILE THE ARMY AND AIR FORCE ARE WORKING ON HOT PRESSING CERAMICS, THE SUB-COMMITTEE DETERMINED THAT THE PROPERTIES REQUIRED FOR THE VARIOUS APPLICATIONS BEING PURSUED IN EACH PROJECI WERE DIFFERENT AND WOULD REQUIRE DIFFERENT PROCESSING PROCEDURES. THEREFORE, NO DUPLICATION EXISTS.

OTHER METAL PROCESSES

FY 80 PROGRAM CHANGES REVIEW

2 NEW PROJECTS REVIEWED

D COMMON AREAS IDENTIFIED

NO NEW AREAS

THE SUBCOMMITTEE REVIEWED 2 NEW FY80 PROJECTS AND FOUND NO NEW COMMON AREAS THAT HAD NOT ALREADY BEEN IDENTIFIED IN IHE REVIEW OF FY81 PROJECTS.

THE FOLLOWING COMPUTER PRINTOUT LISTS ALL ACTIVE, APPORTIONMENT AND BUDGET PROJECTS THAT HAVE BEEN CLASSIFIED AS OTHER PROCESSES. THEY HAVE BEEN SORTED BY THE MATERIAL BEING PROCESSED AND ITS APPLICATION.

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| | | | | | | | | | SEL ENGINES | | | | | | | |
|------------------|---|------------------|---------------------|-----------|-------------------------|------------------|---|---------------------|--------------------------------------|------------------|---|---------------------|----------------------------------|------------------|--|---------------------------|
| | CASE TESTING | SPECIFIC PROCESS | | | | SPECIFIC PROCESS | HOT PREBBING | | STRENGTH CERAMICS FOR DIESEL ENGINES | SPECIFIC PROCESS | TOT PRESONA | | | SPECIFIC PROCESS | OLIP CASTING REACTION BONDING HOT PRESSING | |
| | LOW COST ZOMM AL CARTRIDGE CASE TESTING | COMPONENT | ZOMM CARTRIDGE CASE | | CERAMIC ENGINE BEARINGS | COMPONENT | TURBINE ENGINES BEARINGS | | FABRICATION TECHNIQUES FOR HIGH S | COMPONENT | ADIUBATIC DIESEL ENGINES PISTON CAP HEAD LINER CYLINDER WALL LINER VALVES | | PT FOR CERAMIC ENGINE COMPONENTS | COMPONENT | VANES | BLADES Turbine engines |
| TITLE | MT FOR | | | TITLE | MT FOR | | | | FABRICA | | 1 1 1 | TITLE | F 08 | | | |
| STATUS | 2 | APPLICATION | AKMUNITION | STATUS | | APPLICATION | 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | STATUS | | APPLICATION | LAND VEHICLES | STATUS | | PPLICATION | MISSILES | |
| YEARS OF FUNDING | 0 | ď | A 1 | Z | 7.7 | ₫ ◀ | Ĭ. | YEARS OF FUNDING | କ ବ ବ ଅଧାନ | ď | LAND VEH | YEARS OF FUNDING | 91 77 79 | 4 | Ĭ | |
| SERVICE | AIR FORCE | MATERIAL | ALUMINUM | SERVICE | AIR FORCE | MATERIAL | CERAMIC | SERVICE | A A A | MATERIAL | S U U U U U U U U U U U U U U U U U U U | SERVICE | AIR FORCE | MATERIAL | CERAMICS | |
| EFFORT NO | 98#181 | | | EFFURT NO | 72#358 | | 0 0 0 0 0 | EFFORT NO | 1 5053 | | | EFFORT NO | 72M730 | | | |
| | : . | | | | : | | • ! | | | | | | | ; | | |

| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
|---|-----------|----------|---------------------|---------------------------|-------------|---|----------------|--|---|
| | E 3717 | A T | 900 | | I G I | TEMPERATURE TU | RBINE NOZZLE | FOR 10 K | TURBINE NOZZLE FOR 10 KW POWER UNIT |
| | | MATERIAL | APR | PPLICATION | | COMPONENT | | SPECIFIC | IC PROCESS |
| | | CERAMICS | 5 | SCPPORT FECURESTY | F Z | TURBINE ENGI NOZZLE GENERATOR | 0 | AT TOT BEING | HOT PRESSING PRACTION BONDING SINTERING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | OF STATUS TITLE | TITLE | | i | | |
| | DN800651 | Y Y X | 0.60 | | MATER | MATERIAL MANDLING | | | |
| : | | MATERIAL | 494 | APPLICATION | | COMPONENT | | SPECIFIC | IC PROCESS |
| | | OTHER | SOLITS | 80 0 | | ONBOARD MATERIAL | RIAL | MATERIAL | AL MANDLING |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| | DNA00703 | Y > K | 0 | 2 | CRITI | CRITICAL AIRCRAFT B | BEARING REFUR | REFURBIGHMENT | |
| | | MATERIAL | dd V | APPLICATION | | COMPONENT | | SPECIFIC | IC PROCESS |
| : | | STEEL | ALA I | AIRCRAFT OUTINGO AIRCRAFT | | ALAPANAMO DELAPINOS HURON NACINOS DELAPINOS DELAPINOS | 80 W | REMANU | REMANUFACTURE |
| | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | | | | |
| : | 1 5094 | A RORA | 79 | | ALLOY | ALLOY AND ARMOR STE | STEELB TREATED | HITH RARE | EARTH ADDITIVES |
| | | MATERIAL | N V | APPLICATION | | COMPONENT | | SPECIF | SPECIFIC PROCESS |
| 1 | STEE | | CAN | LAND VEHICLES | • | L LAND VEHICLES ARMOR | | RARE E | EARTH ADDITIONS |

| EFFORT NO SERVICE FUNDING STATUS TITLE DNS00646 NAVY MATERIAL APPLICATION COMPONENT STEEL SHIPS EFFORT NO SERVICE FUNDING STATUS TITLE DNS00559 NAVY MATERIAL SHIPS EFFORT NO SERVICE FUNDING STATUS TITLE DNS00359 NAVY MATERIAL APPLICATION COMPONENT STEEL SHIPS MATERIAL APPLICATION COMPONENT STEEL SHIPS MATERIAL APPLICATION COMPONENT STEEL SHIPS MATERIAL HANDLING MATERIAL HANDLING MATERIAL HANDLING MATERIAL APPLICATION COMPONENT STEEL SHIPS MATERIAL HANDLING MATERIAL HANDLING MATERIAL HANDLING MATERIAL APPLICATION COMPONENT STEEL SHIPS MATERIAL HANDLING MATERIAL HANDLING MATERIAL APPLICATION COMPONENT STEEL APPLICATION COMPONENT MATERIAL APPLICATION COMPONENT STEEL APPLICATION COMPONENT STEEL APPLICATION COMPONENT STEEL APPLICATION COMPONENT METERIAL APPLICATION COMPONENT MATERIAL APPLICATION COMPONENT STEEL APPLICATION COMPONENT MATERIAL APPLICATI | | EFFORT NO | SERVICE | YEAR! OF FUNDING | STATUS | 717LE | |
|--|---|---------------------------------------|----------|---------------------|----------|---------------------------------|---------------------|
| EFFORT NO SERVICE FUNDING STATUS TITLE DNS00646 NAVY 80 HYDRAULIC SYSTEM OVERHAUL EFFORT NO SERVICE FUNDING STATUS TITLE DNS00559 NAVY 79 ULTRABONIC WRENCH DEVELOPMENT ATERIAL APPLICATION COMPONENT ATERIAL APPLICATION COMPONENT STEEL SHIPS EFFORT NO SERVICE FUNDING STATUS TITLE DNS00359 NAVY 79 ULTRABONIC WRENCH DEVELOPMENT STEEL SHIPS EFFORT NO SERVICE FUNDING STATUS TITLE 6 8208 ARMY 80 MATERIAL HANDLING MATERIAL HANDLING STATUS TITLE STEEL SHIPS STATUS TITLE COMPONENT STEEL SHIPS STATUS TITLE STEEL SHIPS STEEL SHIPS STATUS TITLE STATUS TITLE STEEL SHIPS STATUS TITLE STATUS TI | | 679008NO | YAV. | 91 | | ULTRABONIC WRENCH DEVELOFMENT | |
| EFFORT NO SERVICE FUNDING STATUS TITLE DNSOOB46 NAVY MATERIAL APPLICATION COMPONENT STEEL SHIPS HYDRAULIC SYSTEM OVERHAUL NATERIAL APPLICATION COMPONENT HYDRAULIC SYSTEMS HYDRAU | | | MATERIAL | d d v | LICATION | COMPONENT | SPECIFIC PROCESS |
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| EFFORT NO SERVICE FUNDING STATUS TITLE STEEL SHIPS HYDRAULIC SYSTEMS | : | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| STEEL SHIPS SUBMARINES SUBMARINES SUBMARINES HYDRAULIC SYSTEMS FEFORT NO SERVICE FUNDING STATUS TITLE DNS00359 NAVY 79 ULTRASONIC WRENCH DEVELOPMENT STEEL SHIPS METAL FASTENERS EFFORT NO SERVICE FUNDING STATUS TITLE 6 8208 ARMY 80 MATERIAL HANDLING AATERIAL APPLICATION COMPONENT STEEL SHIPS MATERIAL APPLICATION COMPONENT STEEL MEAPONS BARRELS, CANNON | | DN800646 | Y V V | 0 | | HYDRAULIC SYSTEM OVERHAUL | |
| EFFORT NO SERVICE FUNDING STATUS TITLE DNS00359 NAVY 79 ULTRASONIC WRENCH DEVELOPMENT MATERIAL APPLICATION COMPONENT STEEL SHIPS HETRIAL FASTENERS EFFORT NO SERVICE FUNDING STATUS TITLE 6 8208 ARMY 80 MATERIAL HANDLING STEEL APPLICATION COMPONENT STEEL APPLICATION COMPONENT STEEL APPLICATION COMPONENT | | | MATERIAL | # A A | LICATION | COMPONENT | SPECIFIC PROCESS |
| EFFORT NO SERVICE FUNDING STATUS TITLE DNS00359 NAVY 79 ULTRASONIC MRENCH DEVELOPMENT MATERIAL APPLICATION COMPONENT STEEL SHIPS METAL FASTENERS EFFORT NO SERVICE FUNDING STATUS TITLE 6 8208 ARMY BO MATERIAL HANDLING STEEL MEAPONS BARRELS, CANNON | | 0 0 0 0 | STEEL | TEO | 90 0 | DUBMARINES HYDRAULIC GYGTERS | PRESSURE TESTING |
| DNSOO359 NAVY 79 ULTRABONIC WRENCH DEVELOPMENT STEEL SHIPS METAL FASTENERS FFORT ND SERVICE FUNDING STATUS TITLE 6 8208 ARMY 80 MATERIAL HANDLING STEEL MEAPONS BARRELS, CANNON | | EFFORT NO | SERVICE | YEARG OF FUNDING | STATUS | TITLE | |
| STEEL SHIPS METAL FASTENERS YEARS OF EFFORT NO SERVICE FUNDING STATUS TITLE 6 8208 ARMY BO MATERIAL HANDLING MATERIAL MEAPONS BARRELS, CANNON | • | DN800359 | NAV | 79 | | ULTRASONIC WRENCH DEVELOPMENT | |
| STEEL SHIPS METAL FASTENERS YEARS OF EFFORT NO SERVICE FUNDING STATUS TITLE 6 8208 ARMY 80 MATERIAL HANDLING MATERIAL APPLICATION COMPONENT STEEL MEAPONS BARRELS, CANNON | 3 | | MATERIAL | 4 P P | LICATION | COMPONENT | SPECIFIC PROCFSS |
| FFFORT NO SERVICE FUNDING STATUS TITLE 6 8208 ARMY BO MATERIAL HANDLING MATERIAL APPLICATION COMPONENT STEEL WEAPONS BARRELS, CANNON | | | STEEL | TO | 56 | EMILE FACTORES | LOSENING FABIENERS |
| 6 8208 ARMY 80 MATERIAL HANDLING MATERIAL APPLICATION COMPONENT STEEL MEAPONS BARRELS, CANNON | | EFFORT NO | SERVICE | YEARS OF FUNDING | STATUS | TITLE | |
| MATERIAL APPLICATION COMPONENT STEEL MEAPONS BARRELS, CANNON | | 6 6208 | ARMY | 00 | | MATERIAL HANDLING | |
| STEEL MEAPONS BARRELS, CANNON | 3 | | MATERIAL | AP | LICATION | COMPONENT | SPECIFIC PROCESS |
| | | , | | 734 | PONG | BARRELS, CANNON | MATERIAL MANDLING |

| | 068 | | 9 I N C |
|-----------------------|---|------------------|---------------------------|
| | CREEP-DAMAGED TURBINE BLA | SPECIFIC PROCESS | HOT ISOSTATIC PARSSING |
| TITLE | MT FOR HIP REJUVENATION OF CREEP-DAMAGED TURBINE BLADES | COMPONENT | TURBINE ENGINES DLADES |
| VEARS OF STATUS TITLE | | APPLICATION | AIRCRAFT |
| YEARS OF FUNDING | 76 | Ž | |
| SERVICE | AIR FORCE | MATERIAL | SUPERALLOY |
| Ö | | | |
| EFFORT NO | ** TIM232 | | |
| | : | | |

OTHER METAL PROCESSES

SUBCOMMITTEE ACCOMPLISHMENTS

- **■** ESTABLISHED GAS TURBINE ENGINE MANUFACTURING TECHNOLOGY WORKING GROUP
- SPONSORED BEARING MANUFACTURING TECHNOLOGY WORKSHOP
- SPONSORED TRI-SERVICE METALS MANUFACTURING TECHNOLOGY STATUS REVIEW

FUTURE SUBCOMMITTEE ACTIVITIES

SPONSOR MINI-SYMPOSIUM AT THE 1980 ANNUAL MTAG MEETING

WORKING GROUP, AND HELD A DUD/INDUSTRY BEARING WORKSHOP AND THE TRI-SERVICE METALS MANUFACTURING TECHNOLOGY PROGRAM STATUS REVIEW. THESE WILL BE ADDRESSED IN MORE THE SUBCOMMITTEE ESTABLISHED THE GAS TURBINE ENGINE MANUFACTURING TECHNOLOGY DELAIL IN THE FOLLOWING CHARTS.

THE SUBCOMMITTEE WILL PLAN AND EXECUTE THE METALS MINI-SYMPOSIUM AT THE 1980 MITAG AWNUAL MEETING.

GAS TURBINE ENGINE WORKING GROUP

FUNCTION

● RECOMMEND COURSES OF ACTION TO

· ESTABLISH MULTI-SERVICE PROGRAMS

FILL MANUFACTURING TECHNOLOGY GAPS

DISSEMINATE MANUFACTURING TECHNOLOGY INFORMATION

THE FUNCTION OF THE GAS TURBINE ENGINE MANUFACTURING TECHNOLOGY WORKING GROUP IS TO RECOMMEND COURSES OF ACTION TO:

- A. ESTABLISH MULTI-SERVICE PROGRAMS
- FILL THE GAPS IN THE THREE SERVICES MANUFACTURING TECHNOLOGY PLANS FOR
- AND DISSEMINATE MANUFACTURING TECHNOLOGY DATA FOR ON-GOING AND COMPLEIED

CHIEF OF THE METALS BRANCH, AIR FORCE MATERIALS LABORAIORY HAS BEEN APPOINTED ITS CHAIRMAN. THE ARMY, NAVY, AND AIR FORCE HAVE DESIGNATED INDIVIDUALS FOR MEMBER-THIS GROUP WAS FORMALLY ESTABLISHED IN MAY OF THIS YEAR, MR, HENRY JOHNSON, SHIP. AND AS A RESULT OF THE METALS SUBCOMMITTEE MEETING THIS SUMMER, SOME INITIAL TASKS HAVE BEEN ASSIGNED.

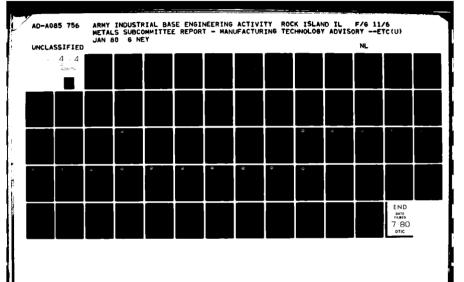
THE TURBINE ENGINE RELATED JOINT PROGRAMS ALREADY DISCUSSED IN THIS REPORT, INFORMALLY, THE GROUP HAD ALREADY TAKEN ACTIONS. BESIDES ESTABLISHING THEY WERE ALSO RESPONSIBLE FOR FORMING JOINT EFFORTS FOR COMPOSITE SHAFTS AND FOR INTEGRATED BLADE INSPECTION SYSTEM,

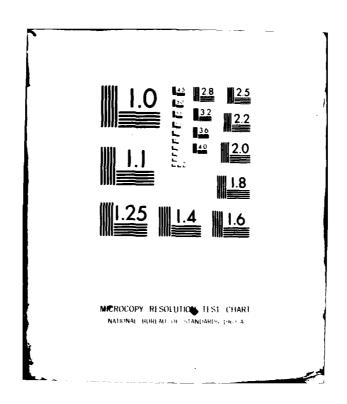
BEARING TECHNOLOGY WORKSHOP

31 JULY-2 AUGUST, SCOTTSDALE, AZ

● 100 ATTENDEES

SPONSORED BY MTAG AND DOD BEARING COMMITTEES





SHOP WAS TO EXPAND THE CONCERNS OF THE DOD BEARING COMMITTEES TO INCLUDE MANUFACTURING FECHNOLOGY. THE DOD BEARING COMMITTEES WORKED VERY HARD IN PREPARATION AND EXECUTION NOT ONLY THE METALS SUBCOMMITTEE BUT ALSO THE TEST AND INSPECTION SUBCOMMITTEE AND THE THREE DOD BEARING COMMITTEES. ONE OF OUR OBJECTIVES IN UNDERTAKING THIS WORK-THE BEARING MANUFACTURING TECHNOLOGY WORKSHOP WAS HELD IN SCOTTSDALE, ARIZONA 31 JULY TO 2 AUGUST. ONE HUNDRED PEOPLE WERE IN ATTENDANCE. IT WAS SPONSORED BY OF THE WORKSHOP AND THEY DESERVE THE LION'S SHARE OF THE CREDIT FOR ITS SUCCESS.

BEARING TECHNOLOGY WORKSHOP

MAJOR CONCLUSIONS

- SIGNIFICANT DOD PROBLEMS EXIST IN PACKAGING AND LUBRICATION
- IMPROVED MANUFACTURING TECHNOLOGY FOR QUIET BEARINGS IS REQUIRED
- NEED FOR IMPROVED NONDESTRUCTIVE INSPECTION TECHNIQUES
- THE RELATIONSHIP BETWEEN SURFACE CONDITION AND BEARING LIFE NOT WELL UNDERSTOOD

CUSSION WAS GENERATED CONCERNING PACKAGING AND LUBRICATION. IT BECAME EVIDENT THAT THESE TOPICS NEEDED TO BE COVERED IN MORE DETAIL. THEREFORE, CONTINUED DIALOGUE WITH INDUSTRY WAS RECOMMENDED IN THE FORM OF AUDITIONAL WORKSHOPS AIMED SPECIFICALLY AT THESE TOPICS. THIS CHART SHOWS SOME OF THE MAJOR CONCLUSIONS REACHED AT THE WORKSHOP. MUCH DIS-

OF QUIET BEARINGS FOR SHIPS AND SUBMARINES. IT WAS UNANIMOUSLY CONCLUDED THAT DOD SHOULD ONE OF THE MOST EMOTIONAL TOPICS DISCUSSED WAS THE PROCUREMENT FROM FOREIGN SOURCES FUND AN MT EFFORT TO IMPROVE THE MANUFACTURING TECHNOLOGY FOR THESE BEARINGS;

THE NEED FOR IMPROVED NON DESTRUCTIVE INSPECTION TECHNIQUES WAS HIGHLIGHTED AT THIS WORKSHOP AS IT HAS BEEN AT ALL OUR WORKSHOPS. THE NEED COVERS THE RANGE OF MATERIAL, DIMENSIONAL AND FUNCTIONAL INSPECTION.

ITS OPERATION. SECOND, THERE IS SURFACE TEXTURE, A COMBINATION OF SURFACE FINISH, CURVA-SEVERAL THINGS. FIRST, THERE IS THE SURFACE CHEMISTRY THAT TAKES PLACE BETWEEN THE METAL AND VARIOUS CHEMICALS THAT ARE BROUGHT INTO CONTACT WITH IT DURING ITS MANUFACTURING AND IURE AND WAVENESS. AND THIRD, THERE IS NEAR SURFACE CONDITION SUCH AS MATERIAL DEFECTS ANOTHER ISSUE WHICH WAS CONTINUALLY RAISED DURING THE WORKSHOP DEALT WITH THE RE-LATIONSHIP BETWEEN SURFACE CONDITION AND BEARING LIFE. BY SURFACE CONDITION, I MEAN JPON BEARING PERFORMANCE AND LIFE, IMPROVEMENTS IN MANUFACTURING TECHNOLUGY COULD BE AND RESIDUAL STRESS. IF WE KNEW MORE QUANTITATIVELY THE EFFECTS OF THESE VARIABLES MORE RATIONALLY SOUGHT.

TRI-SERVICE METALS MANUFACTURING TECHNOLOGY STATUS REVIEW

PLACE: DAYTONA BEACH, FLORIDA

TIME: 25-27 SEPTEMBER 79

NUMBER OF ATTENDEES: 175

THRUST: NET SHAPE PROCESSES

NUMBER OF PAPERS GIVEN: 31

WE SPOWSORED OUR FIRST DOD/INDUSTRY TECHNOLOGY TRANSFER SEMINAR IN LATE SEPTEMBER IN SOLIDIFICATION PROCESSES, POWDER METAL CONSOLITATION PROCESS AND WROUGHT METAL DEFORMA-ION PROCESSES. A DAY WAS DEVOTED TO EACH TYPE OF PROCESS AND THE PAPERS FROM EACH DAY WERE PUBLISHED IN SEPARATE BOOKS. THESE BOOKS WILL BE AVAILABLE FROM THE DEFENSE DOCU-LATEST ADVANCES IN NET SHAPE PROCESSES. THIS DOD SPONSORED WORK COVERED MOLIEN METAL DAYTONA BEACH. 175 ATTENDED THE SEMINAR WHERE 31 PAPERS WERE PRESENTED COVERING THE MENTATION CENTER IN THE NEAR FUTURE.

THE FEED BACK RECEIVED THUS FAR INDICATES THAT THIS MEETING WAS VERY SUCCESSFUL. IN FACT, SEVERAL PEOPLE HAVE SAID THAT IS WAS THE BEST MEETING THAT THEY HAVE EVER

METALS SUBCOMMITTEE ACTIVITIES

PROJECT REVIEW

PROGRAM DATA ANALYSIS

DOD/INDUSTRY DIALOGUE

TION ON MANUFACTURING TECHNOLOGY ACCOMPLISHMENTS AND FUTURE DIRECTIONS OF THE PROGRAM. ANNUAL MTAG MEETING TO CREATE DISCUSSION ABOUT THE TRENDS OCCURRING IN THE SERVICE'S IN ORDER TO MEASURE THE EFFECTIVENESS OF THE SUBCOMMITTEE, ONE MUST EXAMINE OUR PROGRAMS. THE DIALOGUE BETWEEN DOD AND INDUSTRY IS UNDERTAKEN TO EXCHANGE INFORMA-UPON EXCHANGING INFORMATION WHICH LEADS TO IMPROVEMENTS IN THE SERVICES PROGRAMS AND BETTER UTILIZATION OF DOD'S FUNDS. THE DIFFERENCE AMONG THEM IS THE TYPE OF BREAK OUR ACTIVITIES INTO THE THREE TYPES SHOWN HERE. ALL THREE TYPES ARE BASED POTENTIAL DUPLICATION OF EFFORT, PROGRAM DATA AND ANALYSIS IS PRESENTED AT THE PROJECT REVIEW IS PERFORMED BY THE SUBCOMMITTEE MEMBERS FOR THE ELIMINATION OF INFORMATION EXCHANGED AND THE FORUM AT WHICH IT IS EXCHANGED. THE INDIVIDUAL ACTIVITIES AND DETERMINE WHAT ACTIONS HAVE BEEN TAKEN AS A RESULT OF THEM.

PROJECT REVIEW

ACTIONS TAKEN

CALENDAR YEAR

HOW MANY EFFORTS HAVE BEEN DELETED OR DEFERRED, OR HOW MANY HAVE RESULTED IN AGREE-HAVE RECOGNIZED THE ADVANTAGES OF WORKING TOGETHER WHICH HAS LED TO THE PREFERRED ONE MEASURE OF EFFECTIVENESS FOR OUR PROJECT REVIEW ACTIVITIES IS TO EXAMINE ACTION WAS TO DELETE OR DEFER EFFORTS. HOWEVER, MORE RECENTLY, THE SERVICES MENT AMONG THE SERVICES FOR JOINT FUNDING. IN THE BEGINNING, THE PREFERRED ACTION OF FORMING MULTI-SERVICE EFFORTS.

PROGRAM DATA AND ANALYSIS

ACTIONS TAKEN

- MORE DIFFICULT TO ASSESS
- CHIP CUTTING CONFERENCE
- IMPROVEMENTS TO BE SOUGHT

DETERMINING FUTURE SUBCOMMITTEE ACTIVITIES

- EXECUTIVE COMMITTEE
- INDUSTRIAL ASSOCIATIONS AND TECHNICAL SOCIETIES

HOW MANY EFFORTS HAVE BEEN DELETED OR DEFERRED, OR HOW MANY HAVE RESULTED IN AGREE-HAVE RECOGNIZED THE ADVANTAGES OF WORKING TOGETHER WHICH HAS LED TO THE PREFERRED ONE MEASURE OF EFFECTIVENESS FOR OUR PROJECT REVIEW ACTIVITIES IS TO EXAMINE ACTION WAS TO DELETE OR DEFER EFFORTS. HOWEVER, MORE RECENTLY, THE SERVICES MENT AMONG THE SERVICES FOR JOINT FUNDING. IN THE BEGINNING, THE PREFERKED ACTION OF FORMING MULTI-SERVICE EFFORTS.

PROGRAM DATA AND ANALYSIS

ACTIONS TAKEN

- MORE DIFFICULT TO ASSESS
- CHIP CUTTING CONFERENCE
- DETERMINING FUTURE SUBCOMMITTEE ACTIVITIES
- IMPROVEMENTS TO BE SOUGHT
- EXECUTIVE COMMITTEE
- INDUSTRIAL ASSOCIATIONS AND TECHNICAL SOCIETIES

WHICH IS CURRENTLY EVIDENT IN METAL REMOVAL. IN ANOTHER EXAMPLE, WE, IN THE SUBCOMMITTEE, ABLE FORMAT. THIS YEAR, WE PLAN TO ATTACK THIS PROBLEM BY CONSULTING WITH THE EXECUTIVE IAVE USED THIS DATA FOR GUIDING OUR OWN FUTURE ACTIONS SUCH AS SELECTING IMPORTANT TECH-ARE NOT SURE THAT WE ARE PROVIDING THE RIGHT INFORMATION TO THE RIGHT PEOPLE IN A USE-CUTTING CONFERENCE, WHICH IN TURN WAS AT LEAST PARTLY RESPONSIBLE FOR THE MAJOR THRUST IT IS DIFFICULT TO PINPOINT THE PROGRAM CHANGES THAT HAVE RESULTED FROM PROVIDING THE TYPE OF DATA AND ANALYSIS CONTAINED IN THIS REPORT. HOWEVER, THERE ARE EXAMPLES ANNUAL MEETING RE-ENFORCED DOD'S CONCERN THAT INSUFFICIENT EMPHASIS WAS BEING PLACED WOLOGY AREAS FOR OUR WORKSHOPS. HOWEVER, WE BELIEVE THAT IMPROVEMENTS CAN BE MADE. CUMMITTEE AND WITH THE INDUSTRIAL ASSOCIATIONS AND TECHNICAL SOCIETIES TO DETERMINE OF HOW THIS DATA HAS BEEN USED. FOR EXAMPLE, THE DATA WE PROVIDED AT THE 1976 MTAG ON TRADITIONAL METAL REMOVAL PROCESSES. THIS CONCERN LED TO THE DOD/INDUSTRY CHIP WHAT IMPROVEMENTS SHOULD BE MADE.

DOD/INDUSTRY DIALOGUE

ACTIONS TAKEN

CALENDAR YEAR

| | 75 | 76 | " | 75 76 77 78 79 80 | 79 | 8 |
|---------------------------------------|----|----|---|-------------------|----|---|
| TECHNOLOGY ASSESSMENT WORKSHOPS | | | 1 | 2 | - | က |
| TECHNOLOGY TRANSFER SEMINAR | | | | | 2 | - |

TIONS AND TECHNICAL SOCIETIES AGREED TO REVIEW AND COMMENT ON THE SERVICES BUDGET PROGRAMS ALSO FOUND IT DIFFICULT TO RESPOND TO THE COMMENTS THAT WERE MADE. AN ALIERNATE VEHICLE PROJECTS, AND DIVERSITY OF PROCESSES AND APPLICATIONS 10 BE REVIEWED. THE SUBCOMMITTEE SUBCOMMITTEES WERE ESTABLISHED. AS A RESULT OF THAT MEETING AND OTHERS, THESE ASSOCIA-THE DOD/INDUSTRY DIALOGUE BEGAN WITH INDUSTRY, THROUGH THE INDUSTRIAL ASSOCIATIONS AND FIVE YEAR PLANS. IN THE METALS AREA, THE ASSOCIATIONS AND SOCIETIES FOUND IT DIF-DIGESTABLE SUBJECTS AND TO SEEK THE ADVICE OF A LARGER NUMBER OF INDUSTRIAL, ACADEMIC, AND TECHNICAL SOCIETIES, ATTENDING THE ANNUAL MTAG MEETING IN 1974, THE SAME YEAR THE HAD TO BE FOUND THAT WOULD ALLOW INDUSTRIAL INPUT INTO DOD'S PLANS. THE SUBCOMMITTEE FICULT TO ADEQUATELY REVIEW THE PROJECTS DUE TO THE SHORTNESS OF TIME, THE NUMBER OF AND GOVERNMENT EXPERTS. THE SUBCOMMITTEE HAS SPONSORED FOUR WORKSHOPS THUS FAR AND WORKSHOPS. THESE WORKSHOPS ALLOW US TO BREAK THE METALS AREA IN10 SMALLER, MOKE CHOSE TO EMBELLISH UPON THE AIR FORCE'S CONCEPT OF HOLDING TECHNOLOGY ASSESSMENT HAS THREE MORE IN THE PLANNING PHASE.

INVOLVES TECHNOLOGY TRANSFER SEMINARS. WE HAVE HELD TWO SUCH SEMINARS THIS YEAR AND ANOTHER TYPE OF DOD/INDUSTRY DIALOGUE BEGUN BY THE SUBCOMMITTEE THIS YEAR, WILL HOLD ONE NEXT YEAR.

SUMMARY

ACCOMPLISHMENTS

14 JOINT PROGRAMS ESTABLISHED

■ 6 WORKSHOPS AND SEMINARS HELD

IN SUMMARY, THE SUBCOMMITTEE HAS IN THE PAST FIVE YEARS, ESTABLISHED 14 JOINT PROGRAMS AND SPONSORED 6 WORKSHOPS AND SEMINARS.

SUMMARY

FUTURE ACTIVITIES

13 POTENTIAL JOINT EFFORTS

● 4 WORKSHOPS AND SEMINARS

■ IMPROVE METALS SUBCOMMITTEE REPORT

ESTABLISHING 13 JOINT EFFORTS, HOLDING 4 WORKSHOPS AND SEMINARS AND WILL ATTEMPT IN THE NEXT YEAR, THE SUBCOMMITTLE WILL INVESTIGATE THE POSSIBILITY OF TO IMPROVE THE METALS SUBCOMMITTEE REPORT.

CONCLUSIONS

METALS SUBCOMMITTEE HAS STEADILY GROWN BY UNDERTAKING MORE ACTIVITIES IN MEETING ITS RESPONSIBILITIES

THE LIMIT OF THE RESOURCES WHICH CAN BE REASONABLY EXPECTED TO BE PROVIDED IS BEING APPROACHED

CAREFUL CONSIDERATION WILL HAVE TO BE GIVEN TO ANY FUTURE EXPANSION OF OUR ACTIVITIES

FOR MEETING TRAVEL AND PRINTING EXPENSES. TRAVEL FUNDS, IN PARTICULAR, HAVE BECOME THE SUBCOMMITTEE HAS NO BUDGET OF ITS OWN; AND, THEREFORE MUST RELY ON THE SERVICES ACTIVE DURING THE PAST FIVE YEARS. THERE HAS BEEN STEADY GROWTH IN THE NUMBER AND KINDS OF ACTIVITY WE HAVE UNDERTAKEN IN MEETING OUR RESPONSIBILITIES. MORE IMPOR-SIGNS WHICH ARE BEGINNING TO APPEAR THAT INDICATE WE ARE APPROACHING THE LIMIJ OF WITH THEIR MISSION RESPONSIBILITIES. AT A TIME WHEN THE MANUFACTURING TECHNOLOGY THESE MANHOUR REQUIREMENTS, WHICH ARE PROVIDED BY THE SERVICES, AT TIMES COMPETE AS EVIDENCED BY THE PRECEEDING CHARIS, THE METALS SUBCOMMITTEE HAS BEEN VERY PROGRAM IS GROWING FASTER THAN THE MANPOWER TO MANAGE IT, CAREFUL CONSIDERATION ANTLY, THESE ACTIVITIES HAVE PROVEN TO BE EFFECTIVE AND HAVE HAD A SIGNIFICANT IMPACT UPON DOD'S METALS MANUFACTURING TECHNOLOGY PROGRAM. HOWEVER, THERE ARE THE RESOURCES WHICH CAN REASONABLY BE EXPECTED TO BE PROVIDED BY THE SERVICES. MORE SCARCE DURING THE PAST COUPLE OF YEARS. BUT THE GREATEST CONCERN OF THE RESOURCE PROBLEM IS THE AVAILABLE MANHOURS TO ACCOMPLISH THESE ACTIVITIES. WILL HAVE TO BE GIVEN TO ANY FUTURE EXPANSION OF OUR ACTIVITIES.

APPENDIX A

METALS SUBCOMMITTEE MEMBERSHIP

METALS SUBCOMMITTEE

Chairman

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Manufacturing Technology Division
Industrial Base Engineering Activity
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Rock Island, IL 61299
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Army

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Mr. Joseph DiBenedetto Rock Island Arsenal Engineering Directorate ATTN: SARRI-ENM Rock Island, IL 61299 AV 793-4627, 309-794-4627

Dr. Robert D. French
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Mr. Irving Betz
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& Development Command
ATTN: DRDAR-SCM-P
Dover, NJ 07801
AV 880-5811, 201-328-5811

Mr. Roger Gagne
U.S. Army Materials and
Mechanics Research Center
ATTN: DRXMR-ER
Watertown, MA 02172
AV 955-3436, 617-923-3436

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Army-Continued

Mr. Len Luizzi
U.S. Army Armament Research
& Development Command
ATTN: SARWV-RS-AE
Watervliet, NY 12189
AV 794-5507, 518-266-5507

Mr. Dean Booker
Office of the Project Manager
for Munitions Production Base
Modernization and Expansion
ATTN: DRCPM-PBM-MM
Dover, NJ 07801
AV 880-4084, 201-328-4084

Mr. Albert E. Easterling Applied Technology Lab USA Research & Technology Lab (AVRADCOM) ATTN: DAVDL-U-TAP Fort Eustis, VA 23604 AV 927-2400, 804-878-2400

Mr. Gerald Hall
U.S. Army Armament Readiness
Command
ATTN: DRSAR-IRW
Rock Island, IL 61299
AV 793-5590, 309-794-5590

Mr. John R. Thompson Naval Surface Weapons Center (Code DC-30) Dahlgren, VA 22448

AV 249-8411, 703-663-8411

Mr. Richard Grollo Naval Ordnance Station (Code 85) Louisville, KY 40214 Mr. Sam Goodman
U.S. Army Tank-Automotive
Research & Development Command
ATTN: DRSTA-RKA
Warren, MI 48090
AV 273-1814, 313-756-1814

Mr. John Melonas U.S. Army Missile Command ATTN: DRDMI-RLM Redstone Arsenal, AL 35809 AV 746-2810, 205-876-2810

Mr. Robert Coyle
U.S. Army Armament Research
& Development Command
ATTN: DRDAR-LCM-M
Dover, NJ 07801

Navy

Mr. Joseph R. Crisci David Taylor Naval Ship R&D Center (Code 282) Annapolis, MD 21402 AV 281-2462, 301-267-2462

Mr. William T. Highberger Naval Air Systems Command (Code 52031D) Washington, DC 20361

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Navy-Continued

Mr. Joseph Bloomer Naval Ship Engineering Center (NAVSEA) Philadelphia Division Code 6721C Philadelphia, PA 19112 AV 443-3285, 215-755-3285

Mr. Howard Miller NAVAIR 5162C3 Naval Air Systems Command Washington, DC 20361 AV 222-7640, 202-692-7640

Mr. Charles Johnson Naval Weapons Center Code 3624 China Lake, CA 93555 AV 245-3665, 714-939-3665

Mr. Gioranni Silvestri Naval Underwater Systems Center Newport Laboratory Group Code 363012 Newport, RI 02804 AV 948-4032, 401-841-4032 Mr. William J. Welsh
Naval Material Industrial
Resources Office
(Code 224)
Philadelphia, PA 19112
AV 443-3991, 215-755-3991

Mr. Joseph Glatz Naval Air Propulsion Center Code PE43 P.O. Box 7176 Trenton, NJ 08628 AV 443-7224, 609-882-1414

Mr. David Henderson Naval Weapons Engineering Support Activity (Code ESA-824) Washington Navy Yard AV 288-3753, 202-433-3753

Air Force

Mr. Robert Ondercin Air Force Materials Laboratory ATTN: AFML/LTM Wright-Patterson AFB, OH 45433 AV 785-5151, 513-255-5151

Mr. Fred Miller
Air Force Materials Laboratory
ATTN: AFML/LTM
Wright-Patterson AFB, OH 45433
AV 785-5151, 513-255-5151

Mr. William Harris Air Force Materials Laboratory ATTN: AFML/LTM Wright-Patterson AFB, OH 45433 AV 785-5151, 513-255-5151

Mr. James Lawyer
Mr. George Shearer
Air Force Logistics Command
ATTN: AFLC/MAX

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NASA Liaison Representatives

Mr. Jim H. Ehl Marshall Space Flight Center Code FSFC/44 Huntsville, AL 35812 205-453-1649 Mr. Charles Blankenship Lewis Research Center 21000 Brookpark Road (Code LeRC/433) Cleveland, OH 44135 216-433-4000, EXT. 6922

Industry

Aerospace Industries Association

Mr. Reed Yount
Manufacturing Technology Lab
Mail Drop E69
Interstate 75
Cincinnati, OH 45215
513-243-2508

American Defense Preparedness Association

Mr. G. B. Barthold Aluminum Company of America 1600 Harvard Avenue Cleveland, OH 44105 216-641-3600

Society of Manufacturing Engineers

Dr. Richard Kegg
Manager, Research & Development
The Cincinnati Milacron, Inc.
Research Division
4701 Marburg Avenue
Cincinnati, OH 45209
513-841-8594

Forging Industries Association

Mr. G. B. Barthold Aluminum Company of America 1600 Harvard Avenue Cleveland, OH 44105 216-641-3600

American Society for Testing and Materials

Mr. Thomas E. Gregory Western Electric Co., Inc. Dept. 316720 3300 Lexington Road Winston-Salem, NC 27102 919-784-3118

Numerical Control Society

Mr. John C. Williams 11522 Running Cedar Reston, VA 22091 703-860-5416

APPENDIX B

ATTENDANCE LIST
FOR SUBCOMMITTEE MEETING

23-27 July East Hartford, CN

| NAME | ORGANIZATION | PHONE |
|--------------------------|------------------------------------|-----------------------------------|
| John McGovern | NUSC | 447-4725 |
| Gordon Ney | DRXIB-MT | 793 - 6586 |
| John Melonas | DRSMI-EAM | 746-1902 |
| Giovanni Silvestri | NUSC Newport | 948-2617 |
| Fred Miller | AFML/LTM | 785-5037 |
| Howard Miller | NAVAIR AIR-5162 C3 | 222-7640 |
| Michael Redrow | NAVAIR AIR-5162 C313 | 222-7640 |
| Dean J. Booker | DRCPM-PBM-MC | 728 - 6651 |
| Gerald L. Hall | DRSAR-IRW-T | 793-5590 |
| Richard P. Grollo | Naval Ord Station | 989-5339 |
| Ted Highberger | NAVAIR AIR-5163 C3 | 222-7545 |
| Joseph R. Crisci | David W. Taylor Naval Ship R&D Ctr | 281-2462 |
| Robert D. French | AMMRC | 955-3578 |
| Roger A. Gagne | AMMRC | 955 -3436 |
| Albert (Gene) Easterling | ATL (AVRADCOM) | 927-2771 |
| Robert L. Davies | NASA LeRC Cleveland | (216) 433-4000 |
| | | x 6608 |
| Alan Peltz | DRXIB-MT | 793-6586 |
| Irving G. Betz | ARRADCOM-SCM-P | 880-6291 |
| Vito Colangelo | ARRADCOM-DRDAR-AE | 880-5517 |
| John R. Thompson, Jr. | Naval Surface Wpns Ctr (D213) | 249-8105 |
| Eugene Zyblikewycz | NAVMIRO | 443-3991 |
| Bill Welsh | NAVMIRO | 443-3991 |
| Joe Bloomer | NAVSEC Philadelphia | <u> </u> ֈֈֈ3−ֈ ֈ ⊺ֈֈֈ |
| Robert Coyle | ARRADCOM-LCU-M | 880-3121 |
| Sam Goodman | TARADCOM | 273-1814 |
| Joseph W. Glatz | NAPC PE43 | 443-7224 |
| Charles A. Johnson | Naval Weapons Center | 245 -3 665 |
| Joe DiBenedetto | SARRI-ENM | 793-4584 |

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APPENDIX C

LETTER AND CHARTER
ESTABLISHING GAS TURBINE ENGINE
MANUFACTURING TECHNOLOGY WORKING GROUP



DRXIB-MT

15 May 79

SUBJECT: Gas Turbine Engine Manufacturing Technology Working Group

SEE DISTRIBUTION

1. Reference is made to:

- a. Metals Subcommittee Report, dated December 1978.
- b. Letter, DRXIB-MT, dated 22 December 1978, SAB.
- c. Letter, DRXIB-MT, dated 6 March 1978, SAB.
- d. Letter, DIRSO, dated 18 April 1979, SAB.
- 2. The Metals Subcommittee has been responsible for forming quite a few joint service projects in the past couple of years. The majority of these efforts have supported turbine engines for aerospace applications. However, turbine engines are increasingly being used in other military hardware. Examples of these commodities, either under development or in procurement, are tanks, high performance ships, and support equipment such as portable electric generators. While the subcommittee has done a good job of coordinating turbine engine related projects for aerospace applications, I feel we have neglected these other commodities. As a minimum, we need to ensure that the information generated from our turbine engine related projects is made more readily available to the MT communities associated with these other commodities. Furthermore, we should be encouraging these MT communities to sponsor needed efforts for turbine engines.
- 3. I also feel that, while certain segments of our turbine engine MT community are doing an excellant job of interacting with industry, we can do a more effective job by pulling together all segments and collectively interacting with industry.
- 4. In recognition of the above, the Metals Subcommittee felt that a tri-service working group devoted to turbine engines was required and initiated action to establish such a group. Our initial efforts were aimed at establishing this group under a formal charter approved by the MTAG Executive Committee. However, the Chairman of the MTAG,

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DRXIB-MT 15 May 79
Subject: Gas Turbine Engine Manufacturing Technology Working Group

Mr. Charles P. Downer has stated:

"This group should be formed as recommended to coordinate the Tri-Service efforts if there is sufficient evidence that it would be productive and cost effective. The establishment of separate charters for this type of effort is not neccessary as there is sufficient authority in the 31 December 1978 DOD Manufacturing Technology Charter."

5. I believe that the establishment of a working group devoted to turbine engines will prove to be productive and cost effective. Therefore, through this letter, I am establishing the Gas Turbine Engine Manufacturing Technology Working Group. Inclosed is the charter for this group. Mr. Henry Johnson, Chief of the Metals Branch, AFML and Propulsion Focal Point within AFML, has agreed to be its Chairman.

1 Incl

GORDON NEY O
Chairman, Metals Subcommittee

Distribution:

Cdr, WPAFB, ATTN: AFML/LTM, Mr. H.A. Johnson

Cdr, MERADCOM, ATTN: DRDME-VM, Mr. George D. Farmer

Cdr, ARRADCOM, ATTN: DRDAR-SCM-P, Mr. Irving Betz

Cdr, AVRADCOM, ATTN: Mr. Gerald Gorline

Cdr, ARRADCOM, ATTN: Benet Labs, DRDAR-LCB-S, Dr. Vito Colangelo

Cdr, RIA, ATTN: SARRI-ENM, Mr. Joseph Di Benedetto

Cdr, ARRADCOM, ATTN: DRDAR-SCM-P, Mr. Ralph Edelman

Cdr, AMMRC, ATTN: DRXMR-EM, Dr. Robert D. French

Cdr, AMMRC, ATTN: DRXMR-ER, Mr. Roger Gagne

Cdr, ARRADCOM, ATTN: SARWV-RS-AE, Mr. Len Luizzi

Cdr, TARADCOM, ATTN: DRSTA-RKA, Mr. Sam Goodman

PM, Mun Prod Base Mod & Exp, ATTN: DRCPM-PBM-MM, Mr. Dean Booker

Cdr, MIRADCOM, ATTN: DRXMI-RLM, Mr. John Melonas

Cdr, AVRADCOM, Applied Tech Lab, ATTN: DAVDL-U-TAP, Mr. Albert E. Easterling

Cdr, ARRADCOM, ATTN: DRDAR-LCM, Mr. Robert Coyle

Cdr, Naval Surface Wpns Ctr, Code D-213, Mr. John R. Thompson

Cdr, David Taylor Naval Ship R&D Ctr, Code 282, Mr. Joseph R. Crisci

Cdr, Naval Ordnance Station, Code 85, Mr. Richard Grollo

Cdr, Naval Air Systems Command, Code 52031D, Mr. William T. Highberger

Cdr, NAVMIRO, Code 224, Mr. William J. Welsh

Cdr, Naval Air Propulsion Center, Code PE-43, Mr. Joseph Glatz

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DISTRIBUTION (Cont'd)

- Cdr, Naval Air Systems Command, NAVAIR 52022D, Mr. Howard Miller
- Cdr, Naval Ship Engineering Center, Code 6721C, Mr. Joseph M. Bloomer
- Cdr, Naval Weapons Center, Code 3624, Mr. Charles Johnson
- Cdr, Naval Underwater Sys Ctr, Group Code 363012, Mr. Gioranni Silvestri
- Cdr, WPAFB, ATTN: AFML/LTM, Mr. Robert Ondercin
- Cdr, WPAFB, ATTN: AFML/LTM, Mr. William Harris
- Cdr, WPAFB, ATTN: AFML/LTM, Mr. F. Miller
- Cdr, WPAFB, ATTN: AFLC/MAX, Mr. James Lawyer, Mr. George Shearer
- Cdr, Marshall Space Flight Ctr, Code FSFC/44, Mr. Jim H. Ehl
- Cdr, Lewis Research Ctr, Code LeRC/433, Mr. Charles Blankenship

CF:

Cdr, DIRSO, ATTN: Mr. Burton Bartsch Cdr, DIRSO, ATTN: Mr. Charles P. Downer

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CHARTER

GAS TURBINE ENGINE MANUFACTURING

TECHNOLOGY WORKING GROUP

FUNCTION

Provide technical analysis and coordination of the Manufacturing Technology (Man Tech) projects which support gas turbine engines. Identify improved manufacturing technologies which are of concern and have application to the turbine engines used or anticipated for use by the three Services. Recommend courses of action to:

- (1) Establish multi-service programs for common Service needs;
- (2) Fill the manufacturing technology gaps in the turbine engine Man Tech plans of the three Services; and
- (3) Disseminate technology information resulting from completed or on-going projects.

MEMBERSHIP

The Working Group Chairman will be appointed by the Metals Subcommittee Chairman. A Co-Chairman will be appointed by the Working Group Chairman in consultation with the Metals Subcommittee Chairman. The Working Group membership will be made up of representatives from the organizational elements within the Services having responsibilites for the development and application of manufacturing technology for turbine engines. Members will be selected by the Working Group Chairman in consultation with the Primary Metals Subcommittee Service Representatives. The Working Group Chairman will invite participation from NASA and DOE.

ASSIGNMENT

This Working Group shall be assigned functionally to the Metals Subcommittee; and for reporting and administrative purposes, the Working Group Chairman shall report to the Metals Subcommittee Chairman. Since the manufacturing technologies involved in producing turbine engines extends beyond the responsibilities of the Metals Subcommittee, the Working Group Chairman shall keep the Chairman of other MTAG Subcommittees informed of Working Group activities that affect their areas of concern. Furthermore, the Working Group Chairman will inform and work with other DOD Committees where appropriate.

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RESPONSIBILITIES

- 1. The Working Group is responsible for Technical assessment of all Man Tech projects concerned with materials and processes to be used on turbine engines. Technical assessment shall consist of an examination of the projects for technical worth, compatibility with DOD Man Tech objectives, duplication of effort, and potential for joint interest and funding. The findings shall be documented and made part of the Metals Subcommittee Annual Report.
- 2. Establish Tri-Service Turbine Engine Manufacturing Technology Roadmaps which show the relationship among R&D, Man Tech, and actual or proposed acquisition of weapons systems. Each roadmap will identify a Man Tech objective, portray all projects that support that objective, show the inter-relationship among projects, display the cost and schedule for each project, and identify the gaps not covered by the projects.
- 3. Establish a dialogue with industry and solicit their ideas for improving productivity. Work with industry to identify problems and propose solutions.
- 4. Review recently completed Man Tech efforts and recommend areas for application of the technology.
- 5. Annually, the Working Group will assess its accomplishments for the year and will identify the tasks to be accomplished for the coming year. This will be incorporated in the Metals Subcommittee Annual Report.
- 6. Prepare special reports/briefings as required by the Chairman of the Metals Subcommittee or the MTAG Executive Committee.

MEETINGS

The Working Group Chairman will call meetings as required to accomplish the responsibilities listed above. These meetings may take three different forms - full Working Group meetings, special task group meetings, and Working Group/Industry meetings.

GORDON NEY

Chairman,

Metals Subcommittee

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APPENDIX D

TASKING LETTERS



DRXIB-MT

SUBJECT: Corona 5

OIC, Naval Air Sys Cmd, Code 52031D, Mr. William T. Highberger Cdr, WPAFB, ATTN: AFML/LTM, Mr. Robert Ondercin

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the Navy/Air Force investigate the possibility of establishing a joint effort relative to Corona 5. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Ted Highberger of the Navy will have overall responsibility to prepare the plan of action. Mr. Bob Ondercin will act as the primary point of contact for the Air Force.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.

GORDON B. NEY

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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DRXIB-MT

SUBJECT: Small Arms Weapons Manufacturing Technology

Cdr, WPAFB, ATTN: AFML/LTM, Ms Chris Lark Cdr, ARRCOM, DRSAR-IRW-T, Mr. Larry Butler

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the Army/Air Force investigate the possibility of establishing a joint effort relative to Small Arms Weapons Manufacturing Technology. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Larry Butler of the Army will have overall responsibility to prepare the plan of action. Ms Chris Lark will act as the primary point of contact for the Air Force.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.

Chairman

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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DRXIB-MT

8 1 DEC- 1979

SUBJECT: Monocrystal Blades

Cdr, WPAFB, ATTN: AFML/LTM, Mr. Carl Lombard

Cdr, USA Research & Tech Lab (AVRADCOM), ATTN: DAVDL-U-TAP, Mr. Jan Lane

Cdr, TARADCOM, ATTN: DRSTA-RKA, Dr. James Chevalier

OIC, Naval Air Sys Cmd, Code 52013D, Mr. Howard Miller

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the three services investigate the possibility of establishing a joint effort relative to Monocrystal Blades. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Carl Lombard of the Air Force will have overall responsibility to prepare the plan of action. Mr. Jan Lane and Dr. Jim Chevalier will act as the primary points of contact for the Army. Mr. Howard Miller will act as the primary point of contact for the Navy.
- 4. The target completion date for this task should be no later than the end of FY80. Since this task supports turbine engines, and since the metals subcommittee has established the Gas Turbine Engine Manufacturing Technology Working Group, the control of this task will be the working group's responsibility. Therefore, please keep Mr. Henry A. Johnson, chairman of the working group, informed of the major events in the execution of this task.

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chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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3 1 DEC 1979

SUBJECT: Low Cycle Fatigue Life Improvement for Superalloy Castings

Cdr, WPAFB, ATTN: AFML/LTM, Mr. Ken Kojala

Cdr, USA Research and Technology Lab (AVRADCOM), ATTN: DAVDL-U-TAP,

Mr. Jan Lane

OIC, Naval Air Sys Cmd, Code 52013D, Mr. Howard Miller

1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.

- 2. At the referenced meeting it was recommended that the three services investigate the possibility of establishing a joint effort relative to Low Cycle Fatigue Life Improvement for Superalloy Castings. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Jan Lane of the Army will have overall responsibility to prepare the plan of action. Mr. Howard Miller of the Navy and Mr. Ken Kojala of the Air Force will act as the primary points of contact for their respective services.
- 4. The target completion date for this task should be no later than the end of FY80. Since this task supports turbine engines, and since the metals subcommittee has established the Gas Turbine Engine Manufacturing Technology Working Group, the control of this task will be the working group's responsibility. Therefore, please keep Mr. Henry A. Johnson, chairman of the working group, informed of the major events in the execution of this task.

ORDON B. NEY

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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DRXIB-MT

SUBJECT: HIP of Aluminum Castings

OIC, Naval Air Sys Cmd, Code 52031D, Mr. William T. Highberger Cdr, WPAFB, ATTN: AFML/LTM, Mr. Ken Kojala

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the Army/Navy investigate the possibility of establishing a joint effort relative to HIP of Aluminum Castings. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Ted Highberger of the Navy will have overall responsibility to prepare the plan of action. Mr. Ken Kojala will act as the primary point of contact for the Army.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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SUBJECT: Aluminum P/M

Cdr, WPAFB, ATTN: AFML/LTM, Mr. Brian Kosmo

OIC, Naval Air Sys Cmd, Code 52031D, Mr. William T. Highberger

Cdr, Small Caliber Wpns Sys I ab, ATTN: DRDAR-SCM, Dr. Jeffrey Waldman

Cdr, WPAFB, ATTN: AFML Code LLN, Mr. Nate Tupper

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the three services investigate the possibility of establishing a joint effort relative to Aluminum P/M. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Brian Kosmo of the Air Force will have overall responsibility to prepare the plan of action. Mr. Ted Highberger of the Navy and Dr. Jeff Waldman of the Army will act as the primary points of contact for their respective services.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.

AUGORDON B. NEY

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson

OIC, NAVMIRO, Code 224, Mr. William Welsh

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DRXIB-MT

SUBJECT: P/M Bearings

Cdr, WPAFB, ATTN: AFML/LTM, Ms Chris Lark Cdr, AMMRC, ATTN: DRXMR, Dr. Paul Fopiano

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the Army/Air Force investigate the possibility of establishing a joint effort relative to P/M Bearings. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Ms Chris Lark of the Air Force will have overall responsibility to prepare the plan of action. Dr. Paul Fopiano will act as the primary point of contact for the Army.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.

GORDON B. NEY

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh



DRXIB-MT

31 DED 1979

SUBJECT: Laser Assisted Machining

Cdr, AFML, ATTN: AFML/LTM, Mr. William Harris Cdr, TARADCOM, ATTN: DRSTA-RKA, Mr. Sam Goodman OIC, NAVMIRO, Code 224, Mr. William Welsh

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the three services investigate the possibility of establishing a joint effort relative to Laser Assisted Machining. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Bill Harris of the Air Force will have overall responsibility to prepare the plan of action. Mr. Sam Goodman of the Army and Mr. Bill Welsh of the Navy will act as the primary points of contact for their respective sources.
- 4. The target completion date for this task should be no later than the end of FY80. Since this task supports turbine engines, and since the metals subcommittee has established the Gas Turbine Engine Manufacturing Technology Working Group, the control of this task will be the working group's responsibility. Therefore, please keep Mr. Henry A. Johnson, chairman of the working group, informed of the major events in the execution of this task.
- 5. The Army is planning an in-house meeting on metal removal in which this subject will also be discussed. The planned participation of the other services in this meeting will offer an initial opportunity to discuss this potentially joint effort.

GORDON B. NEY

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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DRXIB-MT

SUBJECT: On Line Inspection and Control

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Cdr, AFML, ATTN: AFML/LTM, Mr. William Harris

Cdr, AVRADCOM, ATTN: DRDAV-EXT, Mr. Gerald Gorline

OIC, NAVMIRO, Code 224, Mr. William Welsh

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the three services investigate the possibility of establishing a joint effort relative to On Line Inspection and Control. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Bill Harris of the Air Force will have overall responsibility to prepare the plan of action. Mr. Gerry Gorline of the Army and Mr. Bill Welsh of the Navy will act as the primary points of contact for their respective services.
- 4. The target completion date for this task should be no later than the end of FY80. Since this task supports turbine engines, and since the metals subcommittee has established the Gas Turbine Engine Manufacturing Technology Working Group, the control of this task will be the working group's responsibility. Therefore, please keep Mr. Henry A. Johnson, chairman of the working group, informed of the major events in the execution of this task.
- 5. The Army is planning an in-house meeting on metal removal in which this subject will also be discussed. The planned participation of the other services in this meeting will offer an initial opportunity to discuss this potentially joint effort.

GORDON B. NEY

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson

OIC, NAVMIRO, Code 224, Mr. William Welsh

A Comment with Carrier



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SUBJECT: High Speed Machining of Aluminum

Cdr, AFML, ATTN: AFML/LTM, Mr. William Harris Cdr, TARADCOM, ATTN: DRSTA-RKA, Mr. Sam Goodman OIC, NAVMIRO, Code 224, Mr. William Welsh

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the three services investigate the possibility of establishing a joint effort relative to High Speed Machining of Aluminum. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Bill Harris of the Air Force will have overall responsibility to prepare the plan of action. Mr. Sam Goodman of the Army and Mr. Bill Welsh of the Navy will act as the primary points of contact for their respective services.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.
- 5. The Army is planning an in-house meeting on metal removal in which this subject will also be discussed. The planned participation of other sources in this meeting will offer an initial opportunity to discuss the potentially joint effort.

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Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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SUBJECT: Automation of Conventional Welding Processes

OIC, David Taylor Naval Ship R&D Ctr, Code 282, Mr. Joseph Crisci

Cdr, TARADCOM, ATTN: DRSTA-RKA, Mr. Sam Goodman

Cdr, AFML/ATTN: AFML/LTM, Mr. Fred Miller

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the three services investigate the possibility of establishing a joint effort relative to Automation of Conventional Welding Processes. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Sam Goodman of the Army will have overall responsibility to prepare the plan of action. Mr. Joe Crisci of the Navy and Mr. Fred Miller of the Air Force will act as the primary points of contact for their respective services.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.

GORDON B. NEY

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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SUBJECT: Laser Manufacturing Technology Workshop

Cdr, AFML, ATTN: AFML/LTM, Mr. Fred Miller

Officer in Charge, David Taylor Naval Ship R&D Ctr, Code 282, Mr. Joe Crisci

Cdr, TARADCOM, ATTN: DRSTA-RKA, Mr. Sam Goodman

Cdr, USA MICOM, ATTN: DRXMI-RLM, Mr. John Mellonas

Cdr, USA Research & Technology Lab (AVRADCOM), ATTN: DAVDL-U-TAP,

Mr. Gene Easterling

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting, it was recommended that the subcommittee consider sponsoring a workshop on Laser Manufacturing Technology. This letter is to follow-up this recommendation by appointing an ad hoc committee to evaluate it. This evaluation should take into account similar technology workshops already planned by others and should consider whether the scope of such a workshop should be expanded to include other similar or competing technologies such as electron beam and plasma are applications.
- 3. Mr. Fred Miller of the Air Force will have overall responsibility to conduct this evaluation. Messrs Joe Crisci of Navy and Sam Goodman, John Melonas, and Gene Easterling, all of the Army, will act as primary points of contact within these services.
- 4. Please keep me informed on a timely basis of the status, and occurance of major events in the execution of this task.

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Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson Officer in Charge, NAVMIRO, Code 224, Mr. William Welsh

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SUBJECT: Turbine Engine Seals

Cdr, WPAFB, ATTN: AFML/LTM, Mr. Sylvester Lee Cdr, OSA Research & Tech Lab (AVRADCOM), ATTN: DAVDL-U-TAP, Mr. Jan Lane

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the Army/Air Force investigate the possibility of establishing a joint effort relative to Turbine Engine Seals. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Sylvester Lee of the Air Force will have overall responsibility to prepare the plan of action. Mr. Jan Lane will act as the primary point of contact for the Army.
- 4. The target completion date for this task should be no later than the end of FY80. Since this task supports turbine engines, and since the metals subcommittee has established the Gas Turbine Engine Manufacturing Technology Working Group, the control of this task will be the working group's responsibility. Therefore, please keep Mr. Henry A. Johnson, chairman of the working group, informed of the major events in the execution of this task.

GORDON B. NEY

Chairman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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SUBJECT: Limits of Superplastic Forming/Diffusion Bonding Process

OIC, Naval Air Sys Cmd, Code 52031D, Mr. William T. Highberger Cdr, AFML, ATTN: AFML/LTM, Mr. Shin Inouye

- 1. Reference is made to the Metals Subcommittee Meeting held in Hartford, CN, 23-27 July 1979.
- 2. At the referenced meeting it was recommended that the Navy/Air Force investigate the possibility of establishing a joint effort relative to Limits of Superplastic Forming/Diffusion Bonding Process. This letter is to follow up this recommendation by establishing an ad hoc group responsible for developing the appropriate plan of action. This plan of action should include what needs to be done, who will be responsible for what, when tasks should take place, and what and when funds are required.
- 3. Mr. Shin Inouye of the Air Force will have overall responsibility to prepare the plan of action. Mr. Ted Highberger will act as the primary point of contact for the Navy.
- 4. The target completion date for this task should be no later than the end of FY80. Please keep me informed of the occurrence of the major events in executing this task.

Chalrman,

Metals Subcommittee

CF:

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson OIC, NAVMIRO, Code 224, Mr. William Welsh

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SUBJECT: Mini-Symposium - 1980 Annual MTAG Meeting

Cdr, AFML, ATTN: AFML/LTM, Mr. H. A. Johnson Officer in Charge, NAVMIRO, Code 224, Mr. William Welsh

- 1. Reference is made to the Executive Committee meeting held on 5 Dec 79.
- 2. At the referenced meeting, it was decided that a mini-symposium for the 1980 Annual MTAG Meeting be held. This letter is to follow-up this decision by appointing an ad hoc committee to plan such a mini-symposium.
- 3. The writer will assume overall responsibility for the conduct of this task. Mr. Hank Johnson of the Air Force and Mr. Bill Welsh of the Navy will act as the primary points of contact for their respective services.
- 4. Additional instructions will be forthcoming at a later date.

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Chairman,

Metals Subcommittee

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APPENDIX E

LISTING OF FY80 PROGRAM

ARMY

| Project Number | Project Title |
|----------------|--|
| E 3717 | High Temperature Turbine Nozzle for 10 KW Power Unit |
| R 1052 | Acoustic Emission of Motor Cases |
| R 3294 | Production Processes for Rotary Roll Forming |
| R 3445 | Precision Machining of Optical Components |
| T 4514 | Hard Facing of Track Shoes |
| T 5024 | Gear Die Design and Mfg Utilizing Computer Technology (CAM) |
| T 5053 | Fabrication Techniques for High Strength Ceramics for Diesel Engines |
| T 5068 | New Anti-Corrosive Materials and Techniques |
| т 5082 | Flexible Machining Systems Pilot Line for TCV Components |
| T 5086 | Laser Hardening of Transmission Components |
| T 5090 | Improved and Cast Effective Machining Technology |
| T 5091 | Heavy Aluminum Plate Fabrication |
| T 5092 | Rheocast Pressure Casting for Combat Vehicle Parts |
| T 5093 | High-Speed Machining of TCV Components (Phase I) |
| T 5097 | Integrally Cast Low Cost Compressor |
| т 6007 | Submerged Arc Welding Using Powdered Metals |
| т 6008 | Laser Assisted Machining |
| т 6053 | Welding Systems Integration |
| 1 7036 | Isothermal Roll Forging of Compressor Blads |
| 1 7143 | Ceramic Gas Seal-High Pressure Turbine |

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| Project Number | Project Title |
|---------------------------|---|
| 1 7155 | Cost Effective Mfg Methods for Helicopter Gears |
| 1 7197 | Fabrication of Integral Rotors by Joining |
| 1 7248 | Closed Loop Machining |
| 1 7285 | Cast Titanium Compressor Impellar |
| 1 7298 | High Temperature Vacuum Carburizing |
| 1 7300 | Improved Low Cycle Fatigue Cast Rotors |
| 1 7322 | Low Cost Transpiration-Cooled Combustor Liner |
| 1 7326 | Electron Beam/Inertia Weld Repair Spline Shafts |
| 1 7362 | Engineering Design Handbook for Titanium Castings |
| 1 7366 | Spiral Self-Acting Seal |
| 5 1001 | Pilot Line for Fuze Fluidic Power Supplies |
| 5 4189 | High Fragmentation Steel Production Process |
| 5 43 09 -10 | Forming Tail Fin for APFSDS Projectile |
| 5 4309-11 | Forming Boom of Heat Ammo by Upset Forging |
| 5 4309-12 | Forming of Stub Base Cartridge Case |
| 5 4369 | Techniques to Improve Projectile Cavity Quality |
| 5 4401 | Hot Forming and Cold Heading of Fuze Components |
| 5 4402 | Improved HSS Precision Gear Hobs |
| 5 6716 | Develop Computer-Aided Model of Forming Operations for Artillery Mpts |
| 5 6759 | Automatic Transfer-Hot Forming Presses for Mortar Ammo |
| 6 7916 | Application of Low Cost Mandrel Materials |

| Project Number | Project Title |
|----------------|--|
| 6 7925 | Bore Evacuator Boring |
| 6 7927 | Generation of Base Machining Surface |
| 6 7928 | Robotized Benching Operations |
| 6 7940 | Synergistic Platings with Infused Lubricants |
| 6 7948 | Establish Cutting Fluid Control System |
| 6 8001 | Rapid Flow Plating of Small Caliber Gun Tubes |
| 6 8035 | Coating Tube Support Sleeves with Bearing Materials |
| 6 8102 | Application of Powder Metallurgy Forging Weapons Components |
| 6 8103 | High Velocity Machining |
| 6 8105 | Establish Rough Thread Blanks, 8-inch M201 Bushing |
| 6 8106 | Large Caliber Powder Chamber Boring |
| 6 8107 | Creep Feed Crush Form Grinding |
| 6 8113 | Establishment of Ion Plating Process for Armament Parts |
| 6 8117 | Shaped Castings of ESR Steel |
| 6 8119 | Dimensional Stablization by Vibratory Energy |
| 6 8120 | Adaptive Control Technology |
| 6 8135 | In-Process Control of Machining |
| 6 8151 | Portable Engraving System |
| 6 8152 | Improved Anode Straightness for Chromium Plating |
| 6 8153 | Increasing Gun Tube Heat Treatment Capacity |
| 6 8162 | Improved SC Gun Barrel Rifling Mfg Techniques |
| 6 8163 | P/M Steel Preforms for Small Caliber Weapons |

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| Project Number | Project Title |
|----------------|--|
| 6 8164 | High Speed Machining of SC Weapon Components |
| 6 8165 | Standards for Diamond Turned Optical Parts |
| 6 8341 | Hollow Cylinder Cut Off Machine |

NAVY

| Project Number | Project Title |
|----------------|---|
| DNA00400 | Rare Earth Additions to Titanium Alloys |
| DNA00402 | High Toughness Titanium |
| DNA00700 | High Temperature High Strength Laminate |
| DNA81059 | CAM RAM-DS |
| DNA81062 | Monocrystal Turbine Airfoils |
| DNA81069 | Compressor Seal Scale-up |
| DNA81070 | Thermal Barrier Coating Mfg Process |
| DNA81078 | Premium Aluminum Powder |
| DINSO0388 | Slag/Flux Weld System |
| DNS00537 | High Frequency Resistance Welding |
| DNS00547 | Warhead Component Fabrication |
| DNS00551 | Picle Battery Fabrication |
| DNS00564 | Heat Exchanger Fabrication |
| DNS00572 | Adjustable Post Mock System |
| DNS00641 | Propellor Blade Straightening Machine |
| DNS00648 | CO2 Blaster |
| DNS00649 | Ultrasonic Wrench Development |
| DNS00650 | Magnetic Forming Machine for Rolling Boiler Tubes |
| DNS00665 | Aluminum MIG Argon-Oxygen Gas Mixture |
| DNS00666 | Multiple Mode Welding System |
| DNS00667 | Metal Treatment Process |

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| Project Number | Project Title |
|----------------|--|
| отигоз | MT for DR Powder Blades |
| 01м130 | MT for Effects of Manufacturing Processes on Structural Allowables |
| 01M167 | MT for PM Aluminum Plate Production Scale-Up |
| 01M207 | MT for Abrasive Blade Tips |
| O1M219 | MT for Static Aluminide Components Processing |
| 01M2 59 | MT for Advanced Metal Removal Initiative |
| 01M280 | MT for Advanced Metal Removal Techniques |
| 02M145 | MT for Large Aluminum Precision Forgings |
| 02M163 | MT for Large Titanium Inlet Castings |
| 02M175 | MT for High Ductility Aluminum Castings |
| 02M183 | MT for Advanced Superalloy PM for Rotating Components |
| 02MI.84 | MT for Mono Crystal Turbine Blade Scale-Up |
| 02M2 05 | MT for Advanced Vane and Combustor Fabrication for Small Engines |
| 02M271 | MT for High Speed Machining |
| 0211285 | MT for SPFDB TI Components for Small Engines |
| 08M1.28 | MT for WAAM Metal Parts |
| 08M129 | MT for 20MM Frangible Projectile Fabrication |
| 11M1.02 | MF for Thermal-Mechanical Processing of Low Cobalt Alloys |

| Project Number | Project Title |
|-----------------|---|
| 11M103 | MT for Scale-Up of PM Bearing Materials |
| 11M107 | MT for RQP Disks with LCF Life |
| 11M113 | MT for Scale-Up of Non-Cobalt Weldable Alloys |
| 11W151 | PM Aluminum Longeron Components |
| 11M122 | Low Cost Titanium Wrought Products |
| 11M2O1 | MT for Explosive Fabrication of Engine Components |
| 11M208 | MT for Transporation Cooled Airfoils |
| 11M219 | MT for Repair of SPF/DB Panels |
| 11M220 | Titanium Components for Service Evaluation |
| 11M245 | MT for Repair of ODS Components |
| 12M223 | MT for Low Cost Advanced Titanium Body Structures |
| 12M224 | MT for Low Cost Titanium Propellant Tank |
| 18M134 | MT for Tubular Projectiles |
| 18M139 | MT for Hard Structure Munition Warhead |
| 18M237 | MT for Plasma Sprayed Band Seats |
| 71M148 | MT for HP DS Futectic Blade Fabrication |
| 72M730 | MT for Ceramic Engine Components |
| 9 1M11 6 | High Strength PM Aluminum Mill Products |
| 9 1M15 8 | MT for Rolling High Temperature Sheet |
| 9 1M2O 4 | MT for Innovative Low Cost Tooling |
| 92M204 | MT for Integral Rotating Components by Isothermal Forging |

APPENDIX F

LISTING OF FY81 PROGRAM

ARMY

| Project Number | Project Title |
|----------------|---|
| E 3717 | High Temperature Turbine Nozzle for 10 KW Power Unit |
| R 1018 | Improved Manufacturing Processes for Dry Tune Accelerometers |
| R 3294 | Production Processes for Rotary Roll Forming |
| R 3445 | Precision Machining of Optical Components |
| T 4586 | Improved Large Armor Steel Castings |
| T 5002 | Fabricating Torsion Bar Springs from High Strength Steel |
| т 5006 | Production of Lightweight Steel Cast Trach Shoes |
| T 5007 | Advanced Technology Brake Lining Materials |
| T 5054 | Laser Surface Hardened Combat Vehicle Components |
| т 5068 | New Anti-Corrosive Materials and Techniques |
| т 5080 | Fabrication Methods for High Strength Net Shape Aluminum Transmission Cases |
| T 5081 | Fabrication of Friction Rings and Reaction Plates |
| т 5082 | Flexible Machining Systems Pilot Line for TCV Components |
| T 5088 | High Power Electron Beam Welding |
| T 5090 | Improved and Cost Effective Machining Technology |
| T 5091 | Heavy Aluminum Plate Fabrication |
| 1 7052 | Ultrasonically-Assisted Cold Forming of Titanium Nose Caps |
| 1 7155 | Cost Effective MFG Methods for Helicopter Gears |

| Project Number | Project Title |
|-----------------|--|
| 1 7197 | Fabrication of Integral Rotors by Joining |
| 1 7199 | Surface Hardening of Gears Bearing and Seals by Lasers |
| 1 7240 | Machining Methods for ESR 4340 Steel Helicopter Applications |
| 1 7241 | Hot Isostatic Pressed Titanium Castings |
| 1 7285 | Cast Titanium Compressor Impellar |
| 1 7286 | High Quality Superalloy Powder Production for Turbine Components |
| 1 7291 | Titanium Powder Metal Compressor Impeller |
| 1 7298 | High Temerature Vacuum Carburizing |
| 5 1001 | Pilot Line for Fuze Fluidic Power Supplies |
| 5 1903 | Die Cast Tailcone and Design Machine for Blu-96/B |
| 5 4184 | For Sabot Segments to Net Shape on APFSDS Ammo |
| 5 4189 | High Fragmentation Steel Production Process |
| 5 4309-08 | Processes for Economical Fabrication of Body for APDS Ammunition |
| 5 4309-09 | Investigate Methods for Forming and Heat Treating the Core |
| 5 6 73 8 | Ultra High Speed Metal Removal, Artillery Shell |
| 6 3901 | Manufacture of Fluidic Amplifiers by Cold Forming |
| 6 7605 | Chemically Bonded Sand for Close Tolerance Casting |
| 6 7730 | Manufacture of Split Ring Breech Seals |
| 6 7920 | Conservation of Critical Materials for Gun Tubes |

| Project Number | Project Title |
|---------------------|--|
| 6 7925 | Bore Evacuator Boring |
| 6 7926 | Hot Isostatic Pressing of Large Ordnance Components |
| 6 79 27 | Generation of Base Machining Surface |
| 6 7928 | Robotized Benching Operations |
| 6 7 940 | Synergistic Platings with Infused Lubricants |
| 6 7 94 8 | Establish Cutting Fluid Control System |
| 6 7985 | Small Arms Weapons New Process Production Technology |
| 6 8001 | Rapid Flow Plating of Small Caliber Gun Tubes |
| 6 8004 | Co-Deposition of Solid Lubricants During Anodizing |
| 6 8024 | High Speed Abrasive Belt Grinding |
| 6 8026 | Application of Synthetic Quenchants to Gun Tubes and Heavy Weapon Components |
| 6 8035 | Coating Tube Support Sleeves with Bearing Materials |
| 6 8047 | Pass Thru Steady Rests for Tube Turning |
| 6 8050 | Recycling Spent Gun Tubes by ESR Melting |
| 6 8057 | Dual Rifling Broach Removal System |
| 6 8059 | Salvage of Cannon Components by Electrodeposition |
| 6 8105 | Establish Rough Thread Blanks, 8-inch M201 Bushing |
| 6 8106 | Large Caliber Powder Chamber Boring |
| 6 8107 | Creep Feed Crush Form Grinding |
| 6 8208 | Material Handling |
| 6 8341 | Hollow Cylinder Cut Off Machine |
| 6 8342 | Keyway Milling Machine |

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NAVY

| Project Number | Project Title |
|----------------|---|
| DNA00400 | Rare Earth Additions to Titanium Alloys |
| DNA00402 | High Toughness Titanium |
| DNA00651 | High Production Fluidic Circuit Manufacture |
| DNA00703 | Critical Aircraft Bearing Refurbishment |
| DNA00744 | HIP of Aluminum Castings |
| DNA00746 | High Strength INCO 718 Castings |
| DNA00747 | Corrosion Resistant Turbine Blade Tips |
| DNA00752 | Manufacture of Curved Cooling Holes |
| DNS00274 | Computerized Welding |
| DNS00591 | Mechanized Material Application |
| DNS00635 | Hull Access Holes Automatic Cutting |
| DN S00638 | Automatic Plasma Arc Cutting Machine |
| DNS00646 | Hydraulic System Overhaul |
| DNS00651 | Material Handling |
| DNS00673 | Battery Grid Casting |
| DNS00687 | Dissimilar Metal Pipe Penetrators |
| DNS00693 | Low Cost Machined Optics |

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| Project Number | Project Title |
|-----------------|--|
| C701 | MT for Manufacturing Cost/Design Guide |
| C810 | MT for Sheet Metal Cell Demonstrations |
| T1M184 | MT for Production of Large Near-Net Titanium PM Parts by HIP |
| T1M189 | MT for Advanced TL Powder Production |
| 010805 | MT for Optimal Sheet Metal Center Design |
| 010809 | MT for Optimal Sheet Metal Machine Designs and Transition |
| отитоз | MT for DR Powder Blades |
| 01M121 | Premium Turbine Wheel Castings |
| O1M125 | MT for Joining of PM Disks |
| отит30 | MT for Effects of Manufacturing Processes on Structural Allowables |
| 01M1 67 | MT for PM Aluminum Plate Production Scale-Up |
| 01M206 | MT for Production Scale-Up of 2500 F Seal System |
| 01M207 | MT for Abrasive Blade Tips |
| 0 1M21 9 | MT for Static Aluminide Components Processing |
| 01M242 | MT for Application of SPF/DB Titanium Fabrication |
| 01M259 | MT for Advanced Metal Removal Initiative |
| 01M279 | MT for Vacuum Plasmo Spray Overlay Coatings |
| 01M280 | MT for Advanced Metal Removal Techniques |
| 02M145 | MT for Large Aluminum Precision Forgings |
| 02M163 | MT for Large Titanium Inlet Castings |
| 02M1.72 | MT for Injection Molded Columbium Combustors |

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| Project Number | Project Title |
|------------------|--|
| 0210.75 | MT for High Ductility Aluminum Castings |
| 021083 | MT for Advanced Superalloy PM for Rotating Components |
| 0214184 | MT for Mono Crystal Turbine Blade Scale-Up |
| 021/205 | MT for Advanced Vane and Combustor Fabrication for Small Engines |
| 0211237 | MT for TI MX Shroud |
| 0211271 | MT for High Speed Machining |
| 0211285 | MT for SPFDB TI Components for Small Engines |
| 08MJ.28 | MT for WAAM Metal Parts |
| 08M1.29 | MT for 20MM Frangible Projectile Fabrication |
| 7214248 | MT for HP DS Futectic Blade Fabrication |
| 71M1 69 | Aluminum PM for Precision Parts |
| 711/233 | MT for Producibility of High Temp TI Alloy French Connection |
| 71M868 | MT for Superalloy Engine Ring Rolling |
| 811110 | MT for Manufacturing Scale-Up of Cold Formable TI Sheat |
| 81Na 28 | MT for Improved Superalloy Powder Production |
| 81M208 | MT for Production Demonstration of A-10 Weldbond |
| 81M212 | MT for Mccraly Coating Process Scaleup |
| 81W261 | MT for Machine Tool Task Force |
| 910701 | MT for Unified Sheet Metal Model |
| 9 170.1 6 | High Strength FM Aluminum Mill Products |
| 911124 | MT for Improved Superalloy Powder Production |
| 911/128 | MT for Rolling High Temperature Sheet |

| Project Number | Project Title |
|-----------------|---|
| 9 1MI 67 | MT for Process Effects on Aluminum Casting Allowables |
| 91N50H | MT for Innovative Low Cost Tooling |
| 98MI.26 | MT for Low Cost 20MM Cartridge Cases |
| 98M181 | MT for Low Cost 20MM Cartridge Case Testing |

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